ARCHIVES OF OTOLARYNGOLOGY

VOLUME 3 FEBRUARY, 1926 NUMBER 2

BLASTOMYCOSIS OF THE LARYNX*

CHEVALIER JACKSON, M.D.

PHILADELPHIA

Blastomycosis of the larynx is a rare disease, though probably not as rare as the paucity of literature on the subject would indicate. It is hoped that its recognition as a diagnostic possibility by the laryngeal textbooks of the future will lead not only to its more frequent detection, but to the early diagnosis that may result in cure of the otherwise fatal disease.

REPORT OF CASE

History.—A man, aged 48, a clerk in a general store, was referred by Dr. J. D. Brewer to the bronchoscopic clinic for diagnosis as to the cause of laryngeal stenosis and aphonia, and for cure and decannulation. He was wearing a tracheotomy tube which had been inserted eight months previously.

About two years before admission, the patient developed hoarseness which became progressively worse. On exertion, dyspnea developed within a few months of the onset of hoarseness. A diagnosis of pulmonary and laryngeal tuberculosis had been made, and also a diagnosis of asthma. These conditions were treated by change of climate. The dyspnea increasing, the opinion had drifted more strongly to asthma, and epinephrin was used. This did not improve the dyspnea. Falling into the hands of other physicians, a tracheotomy was performed. After trachetotomy, the laryngeal stenosis apparently was relieved and the cannula was abandoned. The patient struggled along with more or less dyspnea for three or four months; at the end of this time he visited a large clinic where a second tracheotomy was performed, and a specimen was taken which did not confirm the clinical diagnosis of malignant disease of the larynx. After the removal of the specimen the patient's voice had improved.

Symptoms.—There was a subjective sensation of burning and "soreness" of the skin of the neck around the tracheotomic wound, and to a less extent in the larynx and trachea. There was slight cough and a small amount of mucopurulent secretion was expelled from the cannula. There was no history of fever, chills, great loss of strength, or other general symptoms. There was a slight weight loss.

Mirror laryngoscopy showed an infiltrative process involving the left side, part of the right side of the larynx and the intra-arytenoid space. The left cord and left ventricular band were not distinguishable because of the presence of a grayish mass, quite granular below, whitish above, as if brushed with silver nitrate. The infiltrated area was covered with a whitish exudate that was partially cleared away by semi-cough. The left arytenoid was fixed, and the arytenoid half of the epiglottic fold was swollen about twice the normal size. On the right side the cord was replaced by a nodular mass extending from the anterior to the posterior commissure, the mass being covered with

* Read before the meeting of the American Laryngological Association, Washington, D. C., May, 1925.

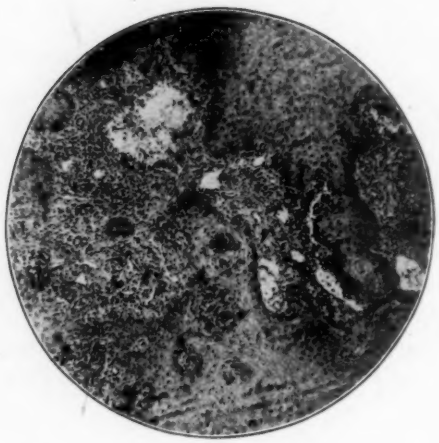


Fig. 1.—Photomicrograph, showing under low power magnification, the histology of the laryngeal lesion in a case of blastomycosis primary in the larynx. The dipping downward of the epithelium is rather suggestive of epithelioma. Near the central portion of the field there is shown a tendency to abscess formation (B. C. Crowell).

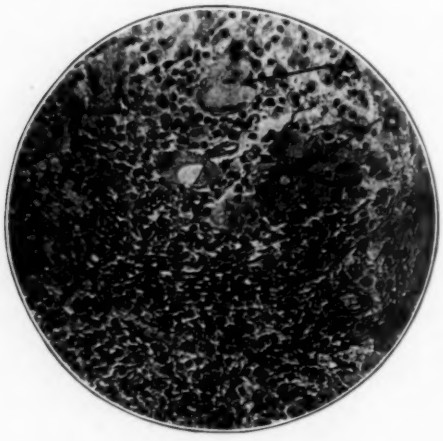


Fig. 2.—Photomicrograph, showing the histology of the lesion in the case of blastomycosis primary in the larynx. The giant cells, *A, B,* are suggestive of tuberculosis. In giant cell *B* is shown the blastomyces, probably dead before the specimen was taken. No mycelia were found in the tissues. (B. C. Crowell.)

shining nodules having the appearance of frog spawn. There was slight motility of the right arytenoid. The right aryepiglottic fold looked inflammatory but was not noticeably enlarged (see color plate).

Direct laryngoscopy showed that the findings of the mirror were confirmed, and, in, addition, the subglottic region was explored. A good view of the right ventricular floor was obtained; the entire floor was covered with whitish nodular excrescences which extended out over the region in which the cord should be and thence down into the trachea. This grayish exudate was continuous with a similar exudate covering the entire tracheal wall and extending down below the tracheotomic cannula. A specimen was taken for biopsy. The tissue cut easily with the biting forceps, but did not come away without resistance, as in cases of cancer or of papillomas.

Neck.—Examination of the neck showed the fistula and tracheotomic cannula in a foul condition, evidencing improper care. The cannula had not been removed for many weeks, and was corroded and roughened.

Surrounding the fistula was a deep, purplish red, nodular, intensely inflammatory rash extending irregularly but symmetrically for a maximum radius of about 3 cm. The general outline was somewhat in the form of a butterfly. The nodules were glistening, some deep crimson, others whitish, others slightly yellowish. Most of them were less than 3 mm. in diameter; many were pinpoint size. The general surface looked raw but not ulcerated; it was covered with a scanty seropurulent secretion with a slight tendency to crusting. The three most striking things about the rash, as compared to the ordinary dermatitis around a neglected tracheotomic cannulated fistula were: (1) the dark, intensely red, almost purplish color; (2) the tiny nodules, and (3), the sharp limitation of the external margin. (See fig. 5, also color plate.) A specimen was taken from this dermal lesion for biopsy.

The following is a report on the histologic examination of tissue by Dr. B. C. Crowell and Dr. B. L. Crawford.

Histology.—"The sections from the larynx show a markedly inflamed and ulcerated mucosa, with considerable hyperplasia of the epithelium. In the submucous tissue there is also extensive inflammatory reaction and fibrosis and numerous small foci containing giant cells, giving it somewhat the appearance of a tuberculous lesion. The inflammatory reaction also involves the cartilage. Sections were examined from the two specimens removed, and histologically the lesion is the same. (Figs. 1, 2, 3 and 4.)

"Sections from the margin of the tracheotomy wound show a marked hyperplasia of the squamous epithelium, and extensive inflammatory reaction involving the epithelial layer and also the subcutaneous tissue. The foci in the skin are composed of polymorphonuclear leukocytes, in which there are many giant cells. In these foci, numerous blastomyces were demonstrated. The fungus was also demonstrated in the sections from the larynx.

"The sections were stained for tubercle bacilli, but none was found. A portion of the tissue was macerated and injected into the groin of a guinea-pig but there was no local evidence of infection and the pig remained well for two months. At necropsy of this pig, no lesion of any kind was found.

Histologic Diagnosis.—"Blastomycosis, involving the larynx and tracheotomy wound." The blastomyces were demonstrated in the sections by Dr. Crowell.

The following is the bacteriologic report of Dr. Crowell. "Cultures were made from scrapings from the skin surrounding the tracheotomy wound, in which the organisms were found abundantly in the sections of the tissue. Cultures were made on glycerin agar, Sabouraud's agar and in maltose broth. All were grown at room temperature, and all tubes gave a growth. On the solid mediums the colonies are confluent, moist, whitish and pasty. The colonies in broth sink and form no pellicle.

"Smears from the cultures show round to oval organisms, the larger ones with a well developed hyaline, double outer membrane. There is a moderate

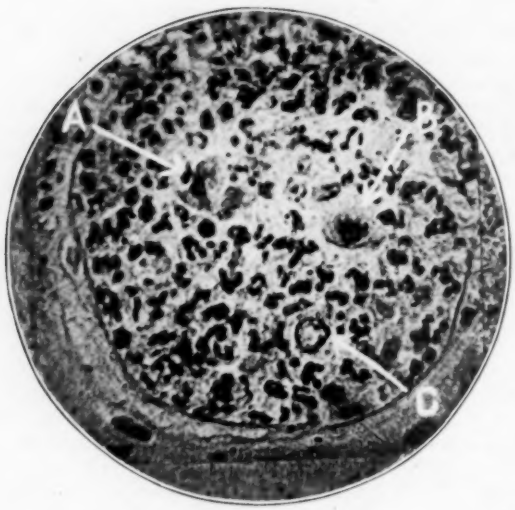


Fig. 3.—Photomicrograph showing the histology in a case of primary blastomycosis of the larynx. At *A* are shown large cells at a stage of the progress toward becoming giant cells. At *C* a blastomycotic organism (*Cryptococcus dermatitidis*) is seen. No mycelia were demonstrated in the tissue but they developed in the cultures. (B. C. Crowell.)

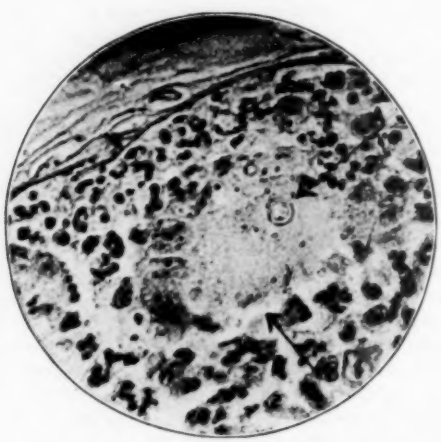


Fig. 4.—Photomicrograph showing at *A*, under high power, the blastomycotic organism within a giant cell. Nuclei are numerous around the giant cell except below it *B*, where they are absent. (B. C. Crowell.)

development of mycelium, but no asci are seen. The hyphæ are septate. Some budding is seen. The action of the organism on other culture mediums has not yet been studied, but the organism seems to comply with the description of *Cryptococcus dermatitidis* (Gilchrist and Stokes, 1898); (synonym, *Cryptococcus gilchristi* Vuillemin)."

Progress.—Consultation with Dr. Frank C. Knowles developed the fact that dermatologists obtain satisfactory results from the internal administration of potassium iodid in blastomycotic lesions of the skin. The patient was placed on 20 drops of a saturated aqueous solution of potassium iodid thrice daily.

At the end of five weeks of treatment, the nodules had disappeared from the skin, except for a few grouped around the margin of the tracheotomic fistula. The discoloration was less intense, though still a rather deep red. The larynx was almost free from the nodules in most of the supraglottic region. The subglottic region still showed a grayish granular, infiltrated area.

Comment.—The skin lesion in this patient did not appear until after the

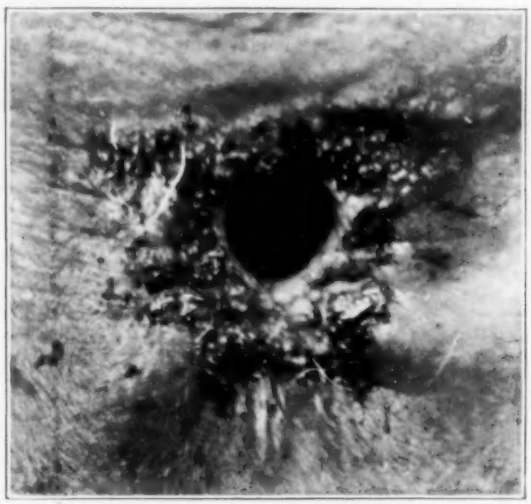


Fig. 5.—Photograph of the front of the neck of a patient showing a blastomycotic dermatitis, the result of extension by continuity from a similar lesion in the larynx. Tracheotomy had been done because of laryngeal stenosis due to primary blastomycosis of the larynx. The butterfly-shaped lesion was an intense dark purplish red and had a moist surface.

tracheotomy, and was evidently an extension by continuity. That the disease was primary in the larynx was clearly evident from the history of absence of lesions or symptoms anywhere else. At the incipiency of the disease, the patient was thoroughly examined for a long period of time by a competent group of physicians in another city, and no lesion other than that in the larynx was found, though the nature of the laryngeal lesion was not evident in the specimens submitted to the histologist in the group. What led us to question the tuberculous diagnosis was the intense deep crimson mucosa with the gray, nodular and, especially, the peculiar "frog spawn" appearance of portions of the interior of the larynx. This appearance we had never seen before and it is the last thing to expect in laryngeal tuberculosis. Furthermore, the lungs were entirely negative, and the patient presented none of the general characteristics of advanced laryngeal

tuberculosis. Had he had an advanced blastomycotic lesion of the lung, it is probable that we would not have taken a specimen, because of an inferential diagnosis of pulmonary tuberculosis.

LITERATURE

Search of eighteen laryngeal textbooks failed to find mention of blastomycosis of the larynx.

Frank L. Dennis,[1] reporting the same case as Downing,[2] found reports of three cases of blastomycosis, in which, at necropsy, the larynx was found to be secondarily involved.

Two cases are reported in the periodical literature, one by Downing and also by Dennis; the other by Sartory, Petges and Claoué.[3] Allotting Numbers 1 and 2 to these cases, respectively, and Number 3 to my own, I have prepared an analysis of the features presented, and hope that the giving of a place to this disease by future textbook writers will result in prevention of the fatal overlooking of the malady in its curable stage.

CHARACTERISTICS PRESENTED BY BLASTOMYCOSIS OF THE LARYNX

Sex.—All three patients were males.

Age.—All three patients were adults, the respective ages being 37, 60 and 48.

Occupation.—These men were, respectively, laborer in a grain elevator, poultry huckster and clerk in a general store. The last patient gave a history of having a cough and "sore throat" noticed while on a farm threshing grain; this occurred seven years before what seemed to be the onset of the disease, and the interval was subjectively symptomless. He had also been in a corn mill frequently, but not for seven years before the apparent onset.

Etiology.—Special exposure is fairly clear in the histories of at least two of the three cases. The first patient (Case 1) gave a clear history of having cleaned out old wood from the bottom of a grain elevator a few days previous to onset of initial symptoms; the second patient (Case 2) was probably exposed almost constantly to fermenting starchy foods in his occupation as poultry huckster; the third patient (Case 3) was a credit clerk in a general store, but had to make trips out on farms at frequent intervals. Previous exposures mentioned in the preceding paragraph seem too remote to be etiologic.

---

1. Dennis, Frank L.: Blastomycosis of the Upper Respiratory Tract, with Report of a Case Primary in the Larynx, Ann. Otol., Rhinol. & Laryngol. **27**:571 (June) 1918.

2. Downing, E. D.: A Case of Blastomycosis with Laryngeal Involvement, J. A. M. A. **70**:85 (Jan. 12) 1918.

3. Sartory, Petges and Claoué: Laryngite chronique pseudo-tubereuleuse d'origine mycosique due a une levure nouvelle, Compt. rend. Soc. de biol. **89**:179, 1923.

Local predisposing factors could not be elicited in two cases. In Case 2, however, there was the vocal abuse of huckstering. General predisposing factors were not evident except in Case 2, in which there was overwork.

Symptomatology.—Initial symptoms in all three cases were hoarseness and cough, at first nonproductive; later there were limited amounts of expectoration, even in the one case (Case 1) in which there was pulmonary involvement. In one case the sputum contained membranous shreds. The cough was severe and paroxysmal in all cases. The onset in one case was described by the patient as a "cold that settled in the larynx." Dyspnea was present in all three patients; two required tracheotomy. Dysphagia was present in two of the three. Progressive loss of bodily strength and weight were present in all three. The temperature was only slightly elevated in two of the patients, probably so in all three. Local subjective sensations of pricking and burning in the region of the larynx and trachea were present in two of the patients.

Pathology.—Necropsy was not performed on the only patient who died. The regions involved besides the larynx were the pharynx, tonsil, trachea and lungs. The skin was involved only in one patient (Case 3), and this was a secondary extension after tracheotomy. Leukocytosis was evident in one patient, the count being 19,000. This was the patient (Case 1) in whom the pulmonary involvement was fatal. Minute abscesses are characteristic of the blastomycotic lesions. In the larynx, those of the abscesses that are superficial rupture on the surface, leaving an ulcerated spot among other as yet unruptured nodules.

Histology.—The histologic picture was suggestive of tuberculosis in all three patients. Inflammatory infiltration, proliferation of the epithelium, giant cells and minute abscesses were present. The characteristic in all three was the presence of spherical, encapsulated parasitic cells. They were demonstrated in the tissues in the three patients. Mycelia were not present in the tissues.

Bacteriology.—The sputum was scanty in all three cases, but the blastomyces were demonstrated in smears of sputum or secretions. Mycelia were demonstrated in the sputum of two of the patients. Sartory, Petges and Claoué (Case 2) believed the organism found to be a new one, to which they gave the name *Cryptococcus laryngitides,* n. sp. They describe the organism as spherical or slightly ovoid, from 4 to 8 microns in diameter. In some instances the contents were homogenous, in others a vacuole with a brilliant granule was noted. These investigators cultured the organism on carrots, potatoes, bouillon, gelatin, agar and Roulin's fluid. Carrots gave a luxuriant growth, white, glossy and moist, soon extending over the entire surface. The best temperature was found to be from 28 to 32 C. Subdermal and peritoneal inoculations in the guinea-pig produced a local lesion, the two

pigs peritoneally injected died in thirty-eight and forty-two days, respectively, with pulmonary lesions in which the parasite was found. In Case 1, an overgrowth of other organisms prevented culturing the blastomyces. In Case 3, Dr. Crowell reported that growth on Sabouraud's medium, on glycerin gelatine and in maltose broth gave an appearance similar in all respects to *Cryptococcus dermatitidis* (Gilchrist and Stokes, 1898). Guinea-pigs were refractory to inoculation.

LARYNGOSCOPIC APPEARANCES

The appearances in the mirror of all three cases were similar, being inflammatory with a grayish, minutely nodular surface in some portions of the lesion, with a few minute, isolated yellowish nodules. In all cases there was in some portion of the lesion an appearance as after an application of silver nitrate, and some of this membrane came away on coughing, leaving a red, inflammatory, eroded and, in small spots, ulcerated surface. In two patients the epiglottis was involved, in one of them there was a V-shaped ulceration on the free margin, the lesion extending onto the tongue. The cords were nodular in only one patient (Case 3) but glottic stenosis was marked in patients (Cases 1 and 3) requiring trachectomy.

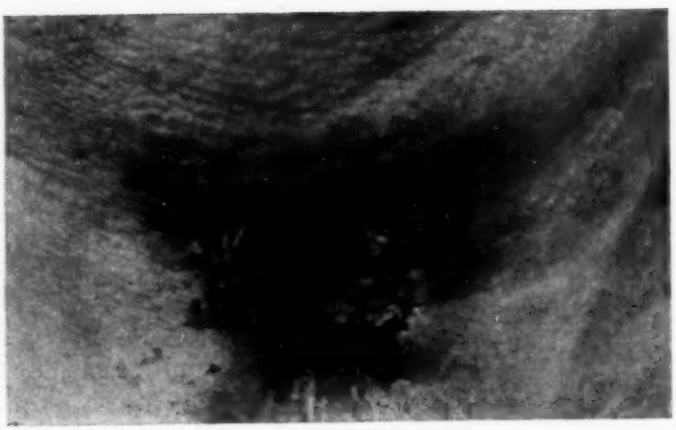
In considering laryngoscopic appearances, it may be well to remember that the stage of the lesion, or part of the lesion, is important. In the early stages it may be flat; the nodules and yellow or grayish points are minute, superficial abscesses. When the abscesses rupture, the lesion flattens at that point. Exudate may cover considerable areas of the lesion. In my case (Case 3) the opaline "frog-spawn" appearance of the tiny nodules was quite unlike anything else I have ever seen in the larynx. The mucosa that was not covered with grayish nodules was deep crimson, the intense redness being in marked contrast to the pallor so often seen in the pale type of laryngeal tuberculosis.

Diagnosis.—The diagnosis can be made with certainty by biopsy, and bacteriologic examinations. Dr. Crowell points out the diagnostically important fact that the blastomycotic organisms are not readily seen in stained sections, hence are likely to be overlooked unless unstained specimens are searched.

Complications.—Pulmonary involvement was slight in one patient and fatal in one. Extension to the skin surface was present in one patient (Case 3). Palpable lymph nodes were absent in one patient (Case 3), and were not noted in the others.

Prognosis.—One patient of the three died of the disease, one recovered, one is still under treatment and is progressing favorably.

Treatment.—The unfavorable results from surgical treatment of blastomycosis of the skin evidently influenced the three observers against surgery in their respective cases. The extension along the



The upper illustration shows a mirror view of the stenotic laryngeal lesion in a case of primary blastomycosis of the larynx. From an oil color drawing by Chevalier Jackson.

The lower illustration is a tinted photograph of the front of the neck, showing the butterfly-shaped dermal lesion, the result of extension by continuity from the larynx after tracheotomy performed for blastomycotic laryngeal stenosis.

UNIV. OF MICH.

tracheotomic fistula in Case 3 seems to furnish support for this view. The good results obtained by the dermatologists with potassium iodid in blastomycotic dermal lesions point to treatment by this drug as the method of choice. The selective effect of potassium iodid on the laryngeal mucosa strengthens the indication for its use. The results in Cases 2 and 3 confirm this theoretic consideration. This remedy, however, failed to arrest the progress of the disease in Case 1, the patient dying of what was probably blastomycosis of the lung. Early diagnosis and treatment might forestall pulmonary extension.

CONCLUSIONS

1. Blastomycosis of the larynx is a rare disease, but may not be quite so rare as the paucity of case reports and the absence of mention in the laryngologic textbooks would seem to indicate.

2. The clinical and even the histologic resemblance of this disease to laryngeal tuberculosis would seem to urge the necessity of the exclusion of blastomycosis in every case of laryngeal tuberculosis in which tubercle bacilli are not found. Concurrent pulmonary blastomycosis may make the clinical picture identical with that of laryngeal tuberculosis in every respect. Blastomycosis is not mentioned in connection with the differential diagnosis of laryngeal tuberculosis in any textbook on laryngeal disease accessible to me.

3. The diagnosis cannot be made positively otherwise than histologically. The structural changes are not conclusive, but fortunately the blastomycotic organisms are easily demonstrated, if the possibility of their presence is kept in mind, otherwise, they are almost certain to be overlooked. They are easiest seen in an unstained specimen, which may account for overlooking them, because of the routine staining of laboratory specimens.

Since the foregoing was written, one of my pupils, Dr. Ernesto Raffo, of Lima, Peru, has called my attention to the large number of cases of blastomycosis that have occurred in Peru, and he has sent me a copy of the *Anales de la Facultad de medicina de Lima,* containing an interesting review of the subject of blastomycosis by Benevente Samuel Lozada.

AUDITORY ACUITY TESTS

COMPARISON OF THE RESULTS MADE WITH TWO TYPES OF AUDIOMETERS *

C. C. BUNCH, PH.D.
IOWA CITY

The passing of the tuning fork as an instrument of precision in measurements of auditory acuity has been brought about by the recent advances in electrical equipment, particularly in the development of the telephone receiver. With an oscillating electric current and a reliable control of this current in the telephone receiver, accuracy and flexibility not to be secured with the tuning forks have been made possible.

Methods for testing the acuity of hearing for diagnostic purposes have developed along two rather widely diverging paths. From one group of examiners we hear the statement that hearing values for a few tones only are necessary. Opposed to these is another group, who insist that values for the tones of the entire audible range are essential for differential diagnosis. The factors determining the method in each individual case are the training and experience of the examiner, the ease of application of the tests, the expenditure of time, the original cost and the upkeep of the apparatus and the diagnostic value of the results.

THE PITCH RANGE AUDIOMETER

During recent years, two types of electrical audiometers have been presented to the otological fraternity. One of these, called the pitch range audiometer, first presented in 1919, produces the electrical current actuating the telephone receiver by means of a special motor generator set. Shortly after this instrument was presented, the possibility of using the vacuum tube as a source of energy for the production of tones for audiometric methods was demonstrated before various American societies.

The results secured from the two types of instruments vary widely in detail. As indicated by the name, the pitch range audiometer determines the acuity of hearing for a continuous limited range of tones, that is, the pitch of the tone is continually changing, similar to the tone of a siren, throughout a specified range. The audiometers of the vacuum tube type have been largely used for a few tones rather widely scattered throughout the audible range,[1] the tones usually selected being

---

* From the Department of Oto-Laryngology, University Hospital.

1. Kranz has recently developed a vacuum tube audiometer, by means of which he can produce a tone of continually changing pitch throughout the different octaves.

octaves and semioctaves of *C*. The pitch range audiometer used in this study produced all tones from 30 to 7,070 double vibrations. The vacuum tube audiometer produces the octaves and semioctaves from 32 to 16,384 double vibrations, twenty tones in all.

In the procedure of securing results with the pitch range audiometer, the intensity is fixed by controlling the current passing through the telephone receiver, and the pitch is gradually changed to determine the audible range at this intensity, this process being repeated at increasing and decreasing intensities until the entire field has been surveyed. In the vacuum tube audiometers, the pitch is fixed and the intensity is gradually decreased to the threshold of audibility and the process repeated for the specified number of tones. In the former, the intensity values are empirical, being determined by the resistances thrown in the telephone circuit. The intensity of the tones in the vacuum tube audiometers are usually given in terms of absolute energy or extrapolations of these values in terms of sensation units.

THE VACUUM TUBE AUDIOMETER

This study was undertaken to show, if possible, the relative value and significance of examinations made with two types of audiometers. Through the courtesy of Dr. Harvey Fletcher of the scientific division of the Western Electric Co., Inc., a vacuum tube audiometer of the type described as No. 1 A in the publications of this company was sent to our laboratory, in order that parallel records might be secured from patients presenting themselves for examination. Since I have, in a measure, been responsible for the development of the pitch range audiometer, am thoroughly conversant with its use, and am perhaps more or less prejudiced as to audiometers and have had very little experience with vacuum tubes, this study might well have been made by one less interested.

The records which are shown here were selected in order to give as much information as possible relative to the merits of the two types of records. In all cases, except as indicated below, they were taken with both instruments at the same sitting, in order that differences could not be due to variations in the acuity of hearing of the patient. Variations in attention cannot be eliminated, except perhaps by repeated tests and the averaging of results. In this study, only one test was run with each instrument. Tuning fork tests were also made, not especially as a check but as a matter of routine. For convenience of description, the records from the 1 A audiometer will be called the *A* curves and those from the pitch range audiometer the *B* curves.

BILATERAL CHRONIC SUPPURATIVE OTITIS MEDIA

Chart 1 shows the records given by a patient having bilateral chronic suppurative otitis media.[2] He also has a 4 + blood Wassermann reaction. The *A* curves for the two ears cross between 64 and 90.5 double vibrations, indicating more acute hearing for these tones in the left ear. This is not verified by the *B* curves which show the right ear to be better, nor by the tuning fork examination (50 double vibrations) which shows that the right ear hears the 50 double vibration fork at 4 inches, which is considered the normal distance for this fork, and the left ear hears it at only 2 inches. The *B* curves show that this fork is heard almost normally in the right ear, while the acuity for the left is considerably diminished. This discrepancy of ten units, or more, in the *A* curves may be due to the attention of the patient. The *A* curves show that both ears have slightly diminished acuity for tones

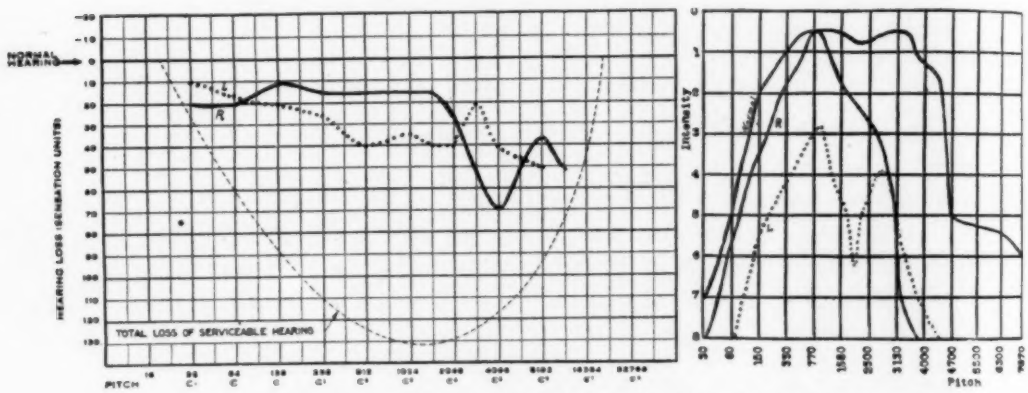


Chart 1.—Records given by a patient with bilateral chronic suppurative otitis media.

The audiograms of the No. 1A Audiometer are copyrighted by the Western Electric Co., Inc., 1924, and are published with their permission.

up to 2,048 double vibrations, the left being somewhat less acute than the right. At 2,048 double vibrations in the *A* curves, the acuity becomes markedly less in the right ear, the curve for the right crossing that for the left between 2,048 and 2,896 double vibrations. This crossing is shown in the *B* curves coming at about 2,800 double vibrations; the most marked deafness shown in the *A* curve for the right being at 4,096 double vibrations. The *B* curves show that the tones from the pitch range audiometer above 3,800 double vibrations were inaudible to this ear. The deep dip in the *B* curve for the left at 2,200 double vibrations is not indicated in the *A* curve for that ear, since no tone of this pitch was given by the 1 A audiometer. The recrossing of the

2. The diagnosis in each case described was given by Dr. L. W. Dean, or by his clinical assistants.

two curves between 5,793 and 8,192 double vibrations is not indicated in the *B* curves, because the intensity above 4,500 double vibrations was not sufficient to produce a sensation in either ear.

NERVE DEAFNESS

The records shown in Chart 2 illustrate the findings in a classical case of nerve deafness. The *B* curve shows the deafness to be increasing for tones above 1,200 double vibrations, no tones above 3,100 double vibrations being audible. The same loss of acuity is shown in the *A* curves, the greatest loss being for tones near 4,096 double vibrations. The rise in the *A* curve at 8,192 double vibrations is not shown in the *B* curve, since this pitch is above the range covered by the pitch range audiometer.

OTOSCLEROSIS

Chart 3 shows the records of a case of otosclerosis. Both charts show a fairly uniform loss of acuity through the entire tonal range, with an approach to normal hearing in the left ear at 5,793 double vibrations, the hearing for the left being slightly better than that for the right ear. The crossing of the curves for the two ears between 724 and 1,024 double vibrations in the *A* curves is not shown in the *B* curves, while the crossing at 4,700 double vibrations in the *B* curves is not indicated in the parallel record.

Chart 4 is also a case of otosclerosis. The record shows a rather marked uniform loss of acuity in each ear up to 4,096 double vibrations in the *A* curve for the right, and to 4,700 double vibrations for the *B* curve for this ear. Again, we note a discrepancy between the *A* and *B* curves for the low tones; the crossing of the right and left curves in the *A* record at 362 double vibrations is not indicated in the *B* curve. The gap at 4,700 double vibrations in the *B* curve is not indicated in the *A* curve, but this gap has been present in curves of tests which have been repeated at intervals over a period of two years, so its absence in the *A* curves must be due to the fact that no tones of this pitch were given by the 1 A audiometer. It may not be probable that such a gap would, at this time and with our present information, influence an otologist in making a diagnosis, but certainly research in the minute anatomy and pathology of the ear must take into consideration such findings in arriving at definite conclusions.

Chart 5, also a case of otosclerosis, shows some discrepancies between the two records. The *B* curve shows the right ear to be more acute than the left for tones up to a pitch of 1,000 double vibrations. The *A* curves show the left to be better for tones between 108 and 1,024 double vibrations. The test for voice perception shows that the right ear hears a forced whisper close to the ear, and hears the spoken voice at

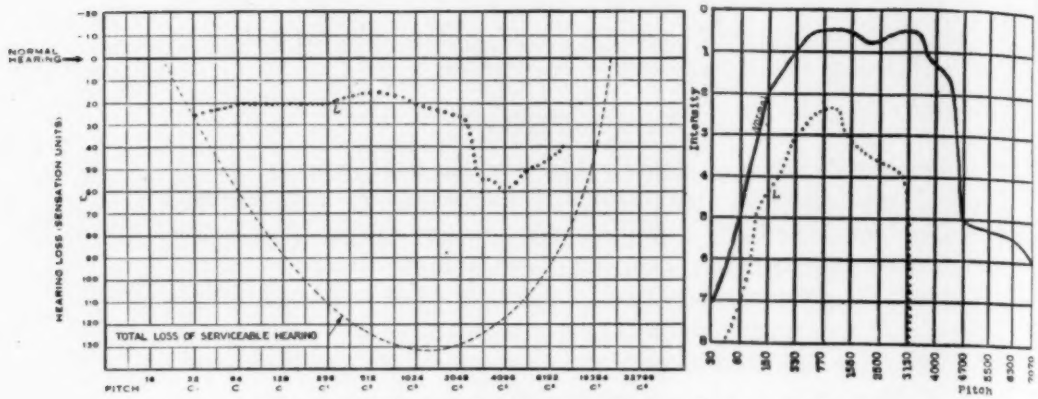


Chart 2.—Findings in a classical case of nerve deafness.

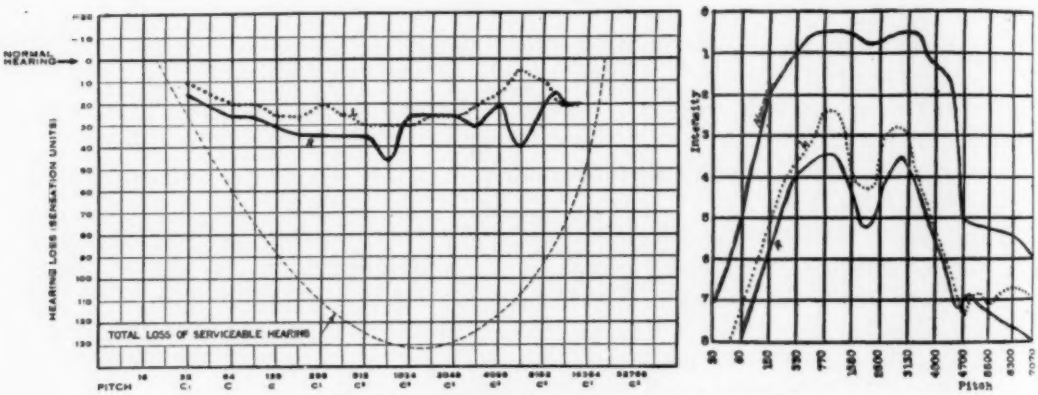


Chart 3.—Records from a case of otosclerosis.

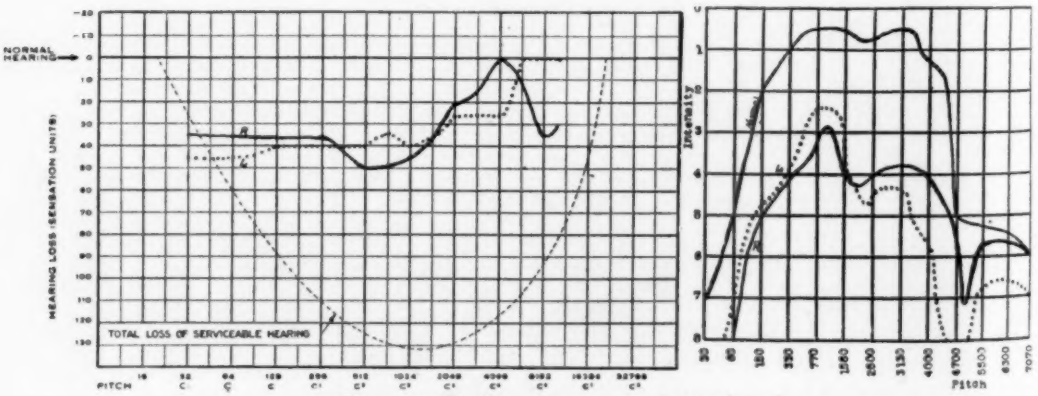


Chart 4.—Findings in a case of otosclerosis.

a distance of 8 inches. The left does not hear a forced whisper, and hears the spoken voice only to a distance of 6 inches. With these two checks it appears probable that the records in the *A* curves are in error. The gap shown at 1,550 double vibrations and the island at 2,800 double vibrations in the *B* curve for the right, appear only as a dip at 1,448 double vibrations and a peak at 2,896 double vibrations in the *A* curve.

INTENSITY OF TONES

These records illustrate in a marked manner the effect of the intensity of the tones from the audiometers on the contour of the curves. The *A* curve shows a practically complete and unbroken curve for both ears, while the *B* curves show only some limited islands for hearing. This raises the question as to what shall limit the intensity of the tones used in tests of auditory acuity. This question has received but little attention in the otologic literature, for the reason that tuning forks of a size easily manipulated have the intensity of the tones emitted automatically limited by their mechanical construction. With electrical instruments, theoretically, there is no limit to the amount of energy output by the telephone receiver except the possibility of burning out the coils with excessive currents. For example, we read of specially constructed loud speakers which are audible at a distance of several miles. In visual tests, the oculist makes an attempt to approximate a standard of illumination of daylight intensity. It is true that the visual and auditory receptors are widely different and have different stimuli, but there should be a limit beyond which excessive stimulation is useless in auditory tests. Such a limit has not as yet been described.

Assuming that the resonance theory of hearing is true, if a defect in the resonating membranes of a very limited extent should exist, according to physical laws, the defective portion could be made to vibrate and carry with it the adjacent nondefective portions of this membrane if sufficient power should be applied. The defect then would appear only as a dip in a hearing curve. The fields of hearing shown in the foregoing, make it appear that this may be the cause of the nonappearance of the gaps in the *A* curves, since the tones from this instrument are extremely intense. It seems possible that this question can be solved by studies in diplacusis, and in variations in pitch discrimination between the two ears.

The nonappearance of these gaps may also be due to the quality of the tones emitted. It is well known that the tones coming from a vibrating diaphragm have their quality particularly dependent on the characteristics of the diaphragm. As nearly as can be determined, the tones when faint are quite pure, but there is no method by which this may be proved absolutely. In both audiometers, when the sounds

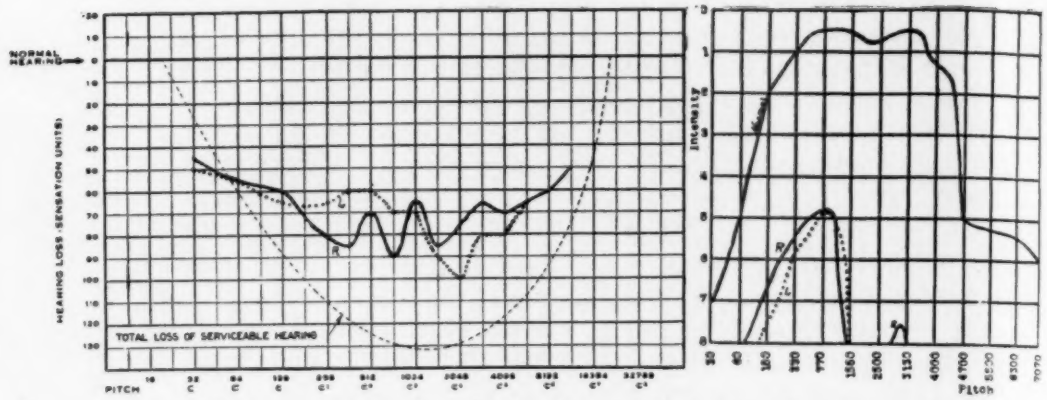


Chart 5.—Otosclerosis, showing discrepancies between the two records.

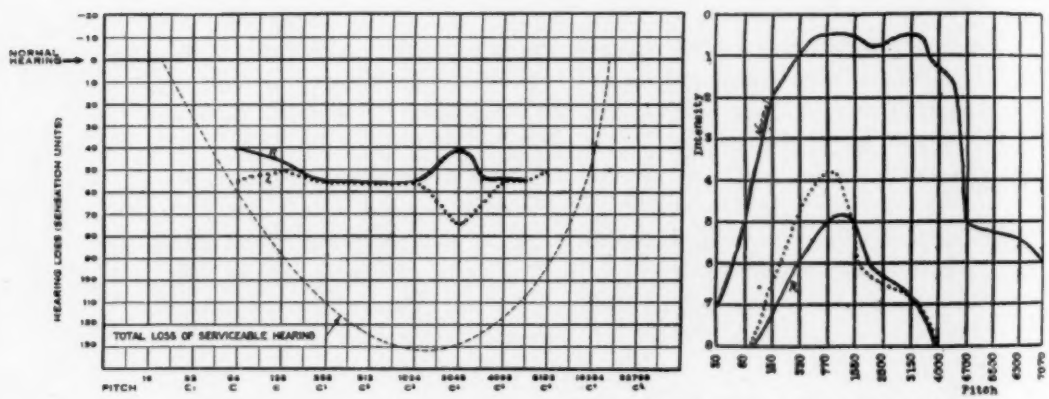


Chart 6.—The records in a case of bilateral acute suppurative otitis media.

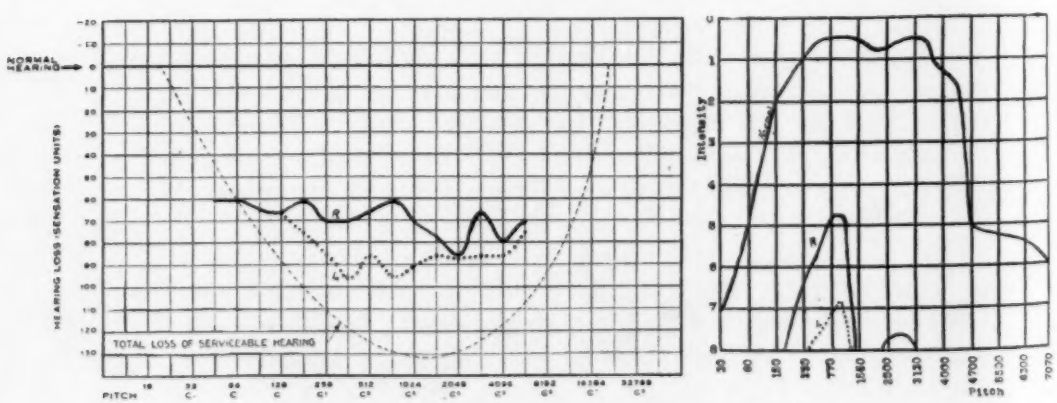


Chart 7.—Records of a case of neurolabyrinthitis.

become loud, we can hear impurities entering, and the louder the tones, the greater the number of overtones. This can easily be determined by noting the "tinny" sound of the excessively loud tones.

BILATERAL SUPPURATIVE OTITIS MEDIA

Chart 6 shows the records in a case of bilateral acute suppurative otitis media. The *A* curves show that the fields for both ears are limited for both high and low tones, the right ear being slightly better than the left. The *B* curves show the right ear to be better only for tones between 1,550 and 3,130 double vibrations. Spoken voice was heard by the right ear at 3 feet and by the left ear at 6 feet. The monochord was heard by the right to 12,000 double vibrations, and by the left to 13,000 double vibrations without any sign of pain. If the monochord is calibrated correctly, neither audiometer had sufficient intensity to reach the upper limit of audibility.

THE EFFECTS OF INCREASING INTENSITY ON TONE

The next four records illustrate in a marked manner the effects on the records of increasing the intensity of the stimulating tones. Chart 7 is the record of a case of neurolabyrinthitis. The dip in the *A* curve for the right at 2,048 double vibrations is shown as a complete gap in the *B* curve. The island in the *B* curve for the left has a much greater extent in the *A* curve, but the range is more narrowed than normal Loud words spoken close to the left ear could not be heard. Chart 8, a case of acoustic neuritis, shows a very narrow gap in the *B* curve for the left ear. The *A* curve gives no indication of this defect. In Chart 9, also a case of acoustic neuritis, the curves for the left agree in the two charts, showing a marked deafness for tones above 2,048 double vibrations, but the islands shown in the *B* curve are only partially demonstrated as dips in the *A* curve.

This raises the question as to the actual existence of islands. Charts 10 and 11, perceptive lesions, show very limited fields with both audiometers. If islands are to be understood as limited portions of the field separated by gaps, this study shows that with increasing intensities of the stimulating tones, the islands become more and more extended. If they are understood to be limited audible ranges lying between regions of deafness, we have ample verification of their existence from both types of audiometers.

DEAFNESS IN NEUROSYPHILIS

Chart 12 shows the records in a case of sudden and rather profound deafness in a case of neurosyphilis. The gaps shown in the *B* curves do not appear in the *A* curves.

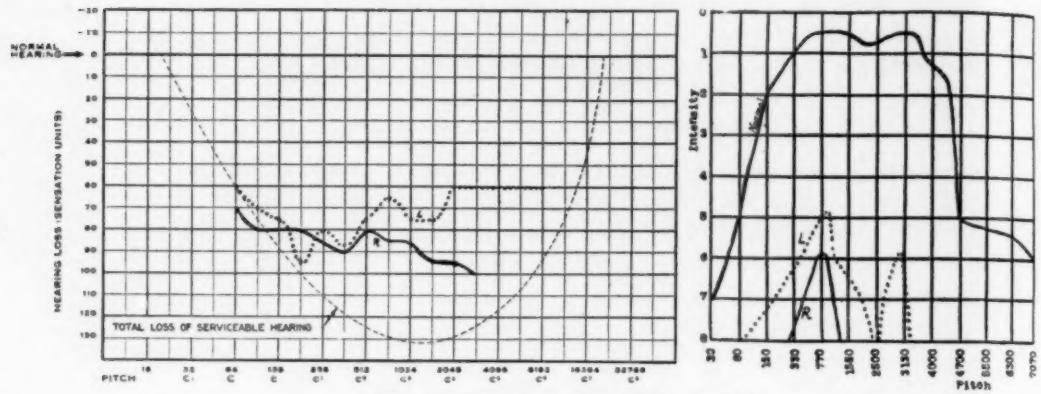


Chart 8.—A case of acoustic neuritis.

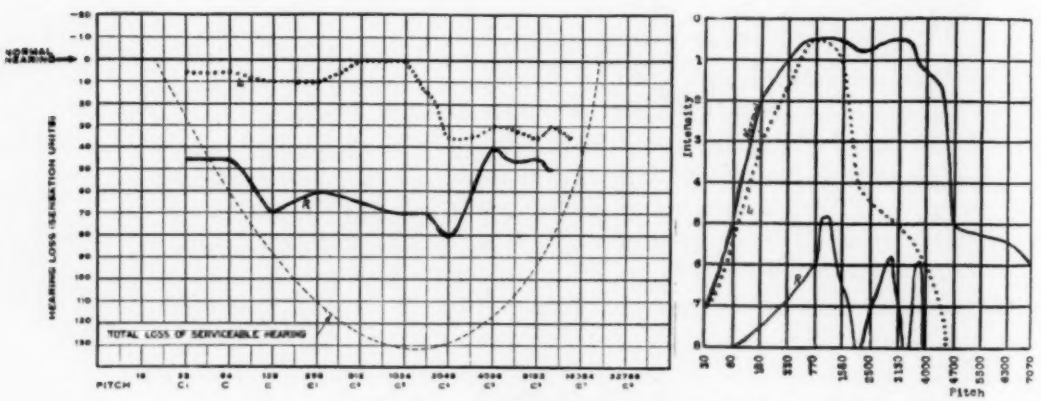


Chart 9.—A case of acoustic neuritis.

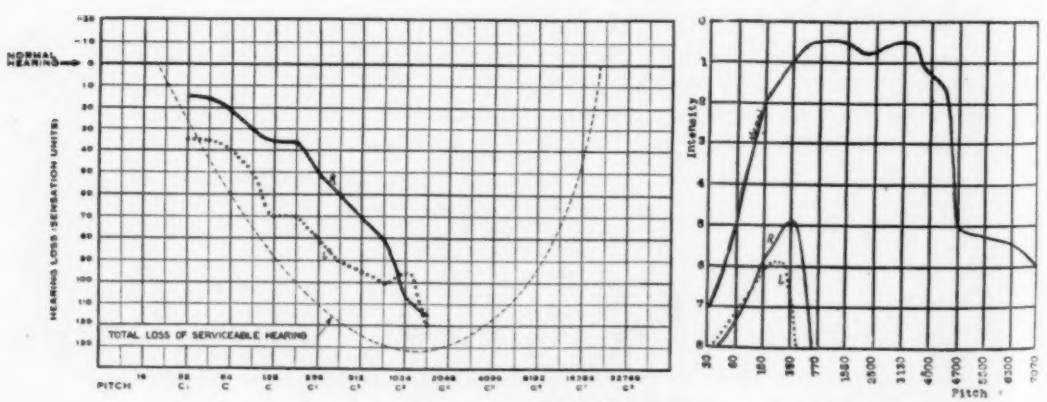


Chart 10.—Perceptive lesions.

BILATERAL CHRONIC OTORRHEA

Chart 13, a case of bilateral chronic otorrhea, in which the patient reported that the left ear had been operated on three times, shows deafness so profound in the left ear that no sounds from the pitch range audiometer could be heard. Loud voice, tuning forks and loud whistles, varying in pitch, were all alike inaudible in this ear, but the *A* curve shows an island of considerable extent. The two islands for the right in the *B* curve merge into an extended island of five octaves in the *A* curve. Unforced voice was heard by this ear at a distance of 4 inches.

DEAFNESS IN SYPHILIS

The patient, a syphilitic, whose record is shown in Chart 14, could hear no tones from the pitch range audiometer, and consequently no *B* curve is shown. He was, in fact, so deaf that none of the noises of tones which could be made in the laboratory, except those indicated in the *A* chart, could be heard. Since the records for the two ears lie almost entirely within the area of the field indicated as "serviceable" hearing, the question arises as to the definition of this term. There was little doubt on the part of the examiner that the patient's reactions indicated auditory stimulation and not that of pain. Judging by the profound deafness, however, the term "serviceable" appears to be a misnomer, for it is difficult to see how these remnants of hearing can be at all serviceable. The patient thought himself entirely deaf.

DEAF-MUTE

The record shown in Chart 15 was secured from a typical so-called deaf-mute, aged 9 years. This child for several years had been attending one of the day schools for the deaf in a neighboring city, and had learned to speak. The quality of the voice was typical of this group of people. Reactions could be secured only for the tones illustrated in the *A* chart. The tones from the pitch range audiometer, loud voice, loud whistles and all other tones which could be produced in the laboratory, were alike inaudible. In view of the fact that tones of this pitch given at this intensity are produced by extreme vibration of the diaphragm, the examiner was doubtful that the curves represented auditory sensation. Due to the age and intelligence of the child, it was impossible to differentiate between feeling and hearing in this case.

CONCLUSION

The gaps shown by the pitch range audiometer in numerous curves appear only as dips in the 1 A audiometer, and narrow gaps do not appear unless the stimulating tone of the 1 A audiometer coincides with the gaps.

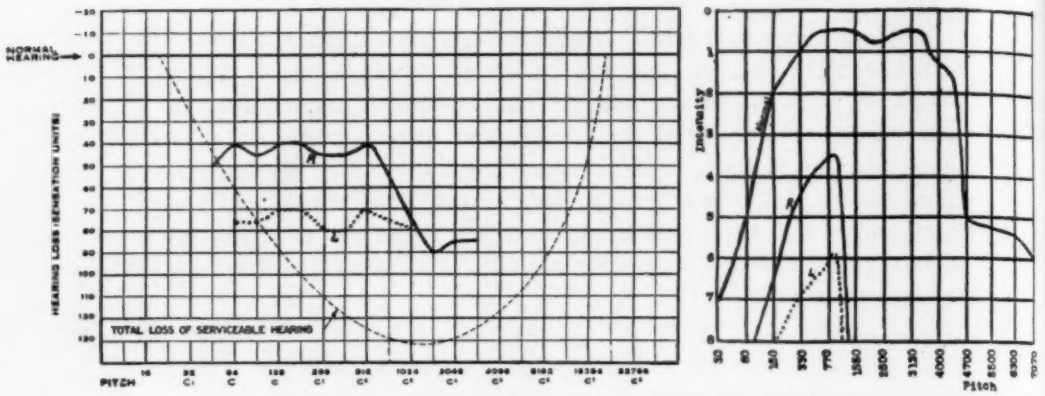


Chart 11.—Findings from a case of perceptive lesions.

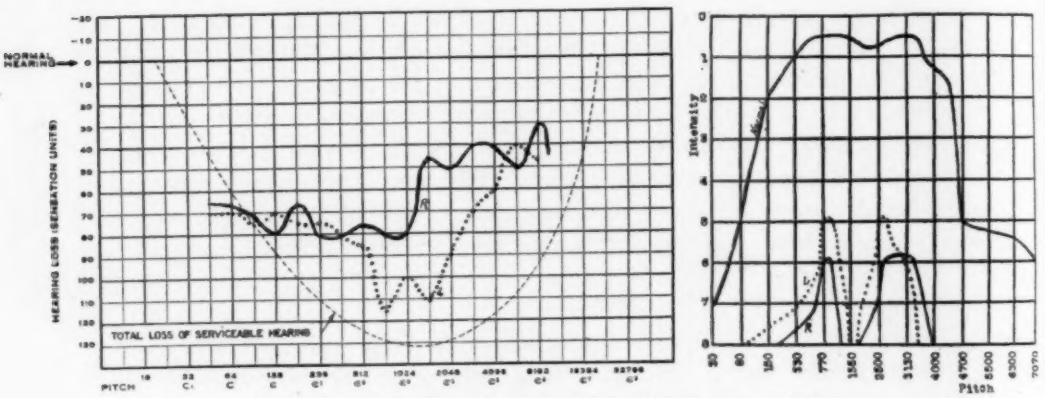


Chart 12.—Records in a patient with neurosyphilis.

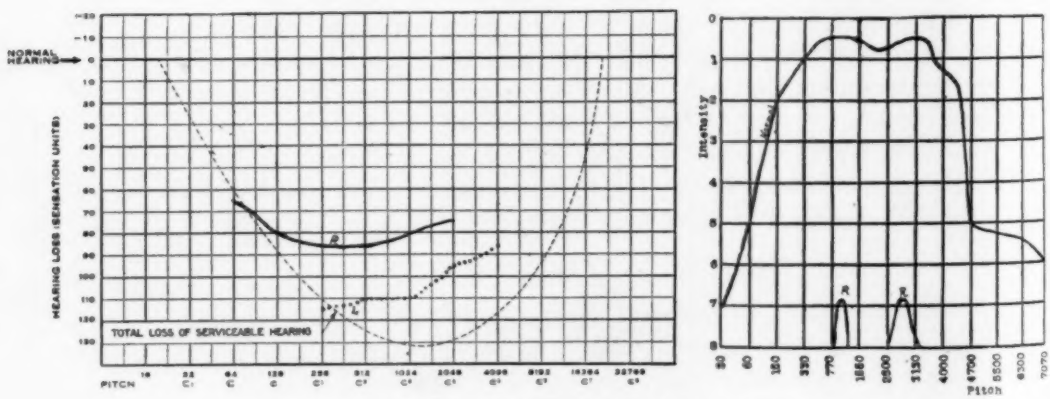


Chart 13.—Bilateral chronic otorrhea.

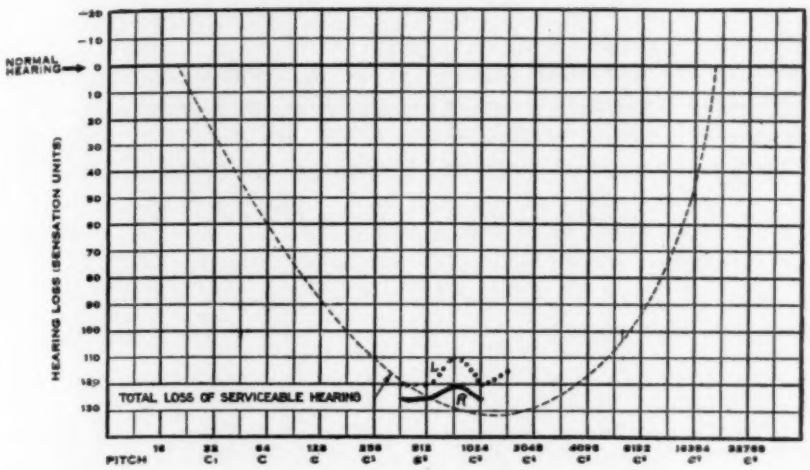


Chart 14.—Record of a case of syphilis.

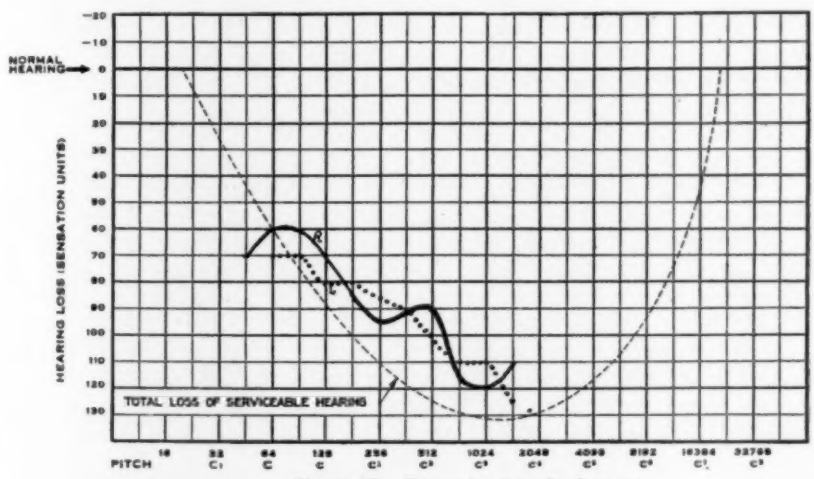


Chart 15.—Record of a deaf-mute.

The tones of the pitch range audiometer are too faint to determine absolute deafness, but are loud enough to indicate loss of hearing for voice. The tones of the 1 A audiometer are sufficiently intense to produce responses in patients deaf to all other tones.

The curve of "serviceable hearing" in the audiograms used for the 1 A audiometer is misleading, unless there is an accurate description of the meaning of the term "serviceable."

In the present stage of diagnostic knowledge, the curves for both instruments present the evidence with clarity much greater than is possible with acuity tests made with tuning forks.

The presence of tonal islands, that is, fields of hearing of limited extent, have abundant verification from both types of instruments. Complete gaps have not appeared in those cases in tests made with the 1 A audiometer.

I should like to express my appreciation of the scientific spirit of the Western Electric Co., Inc., in submitting this No. 1 A audiometer to us for this study. The criticisms which have been offered have, I hope, been offered in the same spirit of research.

TOUCH AS A SUBSTITUTE FOR HEARING IN THE INTERPRETATION AND CONTROL OF SPEECH

ROBERT H. GAULT, PH.D.

Professor of Psychology in Northwestern University, on leave with the National Research Council

WASHINGTON, D. C.

I shall attempt here to give a comprehensive account of experiments relating to a new method of understanding speech and of controlling vocal expression in which I have been engaged more or less uninterruptedly for about three years; during the last year in Washington under the auspices of the National Research Council, and prior to that in the psychologic laboratory in Northwestern University.

The "new method" employs sensations of touch on the skin as cues or suggestions of the meaning of speech. In my experiments, the vibrations of a speaker's vocal apparatus are transmitted through a suitable electrical device to the skin of a "listener." He feels the very vibrations that occasion normal people to hear. So one might speak facetiously of "hearing through the skin," and I have been asked why I devote my time to developing a method whereby people can "hear through their skins" when so few are expert at hearing through their ears. The answer is that my enterprise satisfies a certain scientific curiosity, and besides that there are some thousands of persons for whom hearing is an unknown art. If the human voice can be made to break into them through their skins, well and good. The notion represents a bit of pioneering, and the theory is good. It has stood the test of experiment so far as I have put it to test up to the present time; for I have a group of deaf-mutes who have worked successfully by touch alone with several hundred words and elementary sounds, and who have, in the same manner, interpreted several hundred sentences.

The experiments are psychologic and are limited to the field of tactual sensation or sensations of touch. More particularly, they relate to the niceness with which one can discriminate among groups or patterns of tactual stimuli: stimuli that are applied to the skin of the observer or subject of the experiment when the vibrations of a speaker's vocal apparatus in speech impinge on it through the mediation of a suitable instrument that is held against the observer's skin. The experiments relate to the possibility of remembering these impressions; of developing an imagery in terms of tactual experiences far beyond what we people of normal sensory equipment know anything about. We are interested in the question whether an observer can be brought to a level on which he can recognize these impressions when they recur.

and associate meanings therewith, with something of the matter-of-courseness that characterizes our reception of the auditory phrase: "Good morning! will you have your breakfast?"

Obviously, if one can discriminate by touch the patterns of vibrations that correspond, respectively, to the majority of words used in colloquial English speech; if one can recognize them whenever they recur, and if one can learn to associate meanings with them in turn; if all these subjunctives can become indicatives, we shall have a new method for interpreting speech, of "hearing through the skin;" a method that may have some advantage over the means of communication that are now open to the totally deaf, and to the dull of hearing. At any rate, this new method of understanding speech would offer an escape from the necessity of clearly seeing the moving lips of a speaker.

The question of the possibility of understanding speech then, through impressions made by vocal expressions on the biologically oldest of sense organs—those of touch—is one of the targets of my experimental work.

In the second place, I am aiming at a method whereby tactual impressions may be employed as an aid in vocal control. Because normal people can hear their own voices they are in a good way to correct their speech, and those who are interested make such corrections daily; but the deaf who cannot hear their own voices, to say nothing of those of others, are in a much worse position. They have little reaction from the use of their vocal organs. They have crude criteria at best to guide them in the delicate process of vocal control, and they are all but destined, therefore, to continue mute. Later in this paper I shall state the result of a successful experiment in this connection.

In the third place, there is the much harrassed learner of lip reading and his sorely tried teacher. Is it not possible that the feel of words and sentences on the skin of the learner may be made to reenforce the effort of both the teacher and the pupil? At present, the learner of the art of lip reading has the advantage of seeing the movements of his teacher's lips in speech and of hardly more than that. He might have additional advantage if he could simultaneously see the speaker's moving lips and feel the rhythmic swing of his words—their accent, emphasis and tempo within the sentence and paragraph—all of which he can feel simultaneously by the aid of a suitable device. Here I have named characteristics of speech that aid hearing persons enormously in understanding the spoken language, and it is not improbable, to say the least, that, felt on the skin, they may be made important supplementary criteria for the aid of the lip reader.

It is an *a, b, c* of psychology that the greater the number of angles from which one approaches an object of thought or perception, the

greater is the probability that it will be rich in meaning. It may be better sportsmanship to shoot birds with a rifle, but the shotgun will sooner fill the bag.

In the fourth place, I am interested in the appreciation of music through the tactual sense. The idea is that the deaf may feel a composite of vibrations on their skin: vibrations that are communicated from a musical instrument and that correspond, let us say, to the lower and middle reaches of the musical scale, at least.

I have done no experimental work relating to the last of these problems, and have but begun on the third—relating to a supplement to the current methods of lip reading. So far as this paper is a report of results of experimental inquiry, it is confined to the first two parts: experiments on understanding speech by touch and experiments on the control of vocal expression by the aid of tactual impressions.

The organs of touch biologically are probably the oldest of the organs of sense, while the ear is one of the newest. It has developed out of the skin and is a highly developed mechanism for the reception of touch stimuli.

It would be of great interest in connection with our composite problem to make a reliable comparison of the touch organs in the skin and the ear as to their sensitivity; in other words, how great must be a pressure on the organs of touch in order that one may be aware of contact? How great must be the variations of air pressure on the ear in order that one may be aware of tonal sensation? Of course these questions cannot be answered categorically. We must have regard for the area of the skin that is stimulated and for, at least, the frequency per second of variations of air pressure against the ear.

It has been pointed out by Dr. Harvey Fletcher, of the Bell Telephone Laboratories, that if the intensity of a tone be steadily increased, a point is reached at which the ear experiences a tickling sensation. The intensity of stimulus requisite for this sensation is about the same for all persons. It varies between extremes on the frequency scale. If the same intensity is brought against the finger it arouses the tactile sense.

Now recall that a 2 mg. weight applied to the tip of a finger will awaken a sensation of touch, and we are at once confronted by a plausible hypothesis: namely, the vibrations of the human voice may be so amplified in a suitable instrument and communicated to the skin of the subject that he will be able to feel colloquial speech in all its tonal ranges; that he will be able to distinguish words and sentences by the criteria of touch and to associate meanings therewith. This hypothesis appeals all the more strongly because there is no surety that either in our everyday life or in our laboratories we have sounded the depths of the possibilities of making fine discriminations by touch. Witness the

astonishing tactual discrimination among the blind and in such an occupational group as silk salesmen, not to mention others.

The psychologic process involved in the interpretation of spoken language by touch is quite analogous to that which obtains among hearing people who are employing their ears toward the same end.

Acting on the hypothesis, I have experimented to determine how far one can go in the discrimination of words and sentences by touch alone. I myself have served as a subject in such experiments, having first arranged the experimental situation so that I could not hear what was going on. While I held in my hand the receiver of our telephone-like apparatus similar to the one we are using at present, I felt the words of a speaker at the other end of the system in an adjoining building. I became so familiar with the feel of the names "a," "e," "i," "o," "u"

TABLE 1.—*Age of Subjects and Cause of Deafness*

Subject by Number	Age	Age When Deafness Occurred	Cause of Deafness	Audiometric Record, R L
1	23	6½	Scarlet fever	5- 5
2	17	10	Cerebral meningitis	10-15
3	20	15	Spinal meningitis	20-20
4	23	Congenital	.....	35-40
5	21	7	Spinal meningitis	5- 5
6	22	5	Spinal meningitis	45-15
7	20	3	Spinal meningitis	20-15
8	32	7½	Spinal meningitis	0-10
9	22	1½	Spinal meningitis	5- 0
10	17	9	?	55-45
11	21	Congenital	.....	30-30
12	19	Congenital	.....	55-50
13	19	1½	?	50-50
14	21	8	?	15-45
15	31	4	?	25-35

Note: The audiometric record 5-5 indicates that the subject, in each ear, has 5 per cent of normal reaction to simple tones. No corresponding figures in the table above are necessarily indicative of a capacity to understand spoken words.

that I could identify them in ninety-one cases out of a hundred. Beyond this I could identify upward of fifty words, and many sentences made up of groups of these words in combination. It is literally true that no two of the foregoing names feel alike. I can say the same of other words also—so far as my experience has reached.

I want especially to speak of the experience of my deaf observers in several types of experiment.

On Oct. 8, 1924, I began experiments with fifteen deaf subjects, who were divided into three groups of six, five and four members, respectively. All members of a group simultaneously received impressions of touch on the hand when the experimenter spoke into his transmitter in the adjoining room. Table 1 embodies the important data concerning these cases.

We have repeatedly satisfied ourselves by control tests that hearing through air conduction is not involved in these experiments. Controls

on hearing subjects whose hearing has been eliminated in the experimental situation have convinced us that audition by bone conduction is not a factor worthy of consideration.

Two of these groups were set off with sentences as stimuli. On the wall before them was a chart on which were ten sentences of six monosyllabic words each. At the outset, two of these were read into the transmitter several times to familiarize the subjects with the different feel of the sentences. They were always in the same order: first, second; first, second. Then they were read in an unknown order till a series of ten readings had been finished. Between every two utterances sufficient time was allowed for each subject to write down on his pad the number of the sentence that he thought had just now been pronounced. At the conclusion of the series there was a checking up. Several such

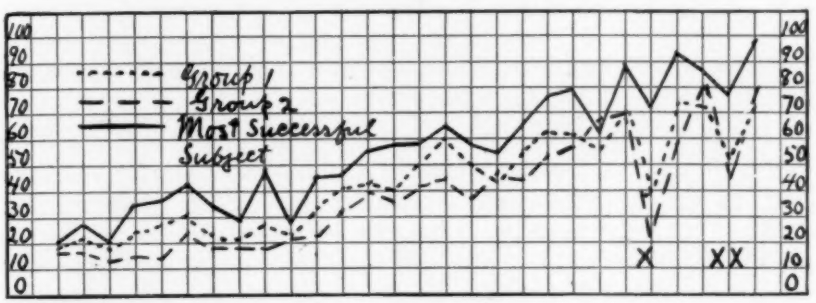


Fig. 1.—Learning curves of eleven cases in two groups, and the most successful subject. The stimuli are ten sentences of six monosyllabic words each. Time, Oct. 8 to Nov. 26, 1924, inclusive. The abscissas are days. One half hour daily, five days weekly. Aggregate, fourteen hours. X = effect of altered rhythm and emphasis. XX = effect of strange voices. Formula: $X = \frac{(R - \left(\frac{1}{n-1}\right) W)\, n}{10}$. X = point on the learning curve. R = number of identification. W = number of wrong reports. N = words in the vocabulary at a given time. All the curves published here have been determined by this formula.

series were completed at a sitting. As rapidly as possible, additional sentences were introduced until all ten were employed at a session. The most successful subjects became able to identify them almost perfectly.

Of course the possibility occurred to me that, since the sentences differed as to rhythm, tempo and emphasis, the flattering proportion of identifications might not mean so much as we should like to believe. Perhaps indentification was on the basis of any one of the factors I have named, or on all of them together and not on the feeling of the words alone. This was easily put to the test. On Nov. 19, 1924, I exaggerated my manner of speaking. I spoke swiftly where I had cus-

tomarily spoken slowly; I placed emphasis at altogether unaccustomed points, and I profoundly altered the usual rhythm in which the sentences were spoken. But in spite of all this violence the subjects maintained a respectable margin of identification above mere chance, as figure 1 indicates. One group lost 40 points and the other 31. They were still 21 and 39 points above a chance distribution. The most successful subject lost 18 points and made a record of 71 above chance.

Another question of great importance is whether our subjects are dependent on the speaker to whom they have become accustomed. Can they identify the sentence stimuli to which I have referred when these stimuli are presented by others than the accustomed experimenter? This question I put to the test on November 24 by employing successively two experimenters in addition to myself. One of them has a voice that is less distinct than my own. He spoke his sentences more rapidly than I was accustomed to doing. His emphasis and tempo differed markedly from my own. The other experimenter has a more distinct utterance than mine. His emphasis and tempo differed from mine, though less decisively than those of the other.

It was to be expected that our subjects would do less well in relation to the strange experimenters than to myself. An analogous situation holds of hearing people when they are thrown among strangers. But the interesting fact is that, as the figure above shows, they were far from losing all that they had gained from their tactual experience with my own voice. The most successful subject lost only 11 points and made 78. The group that lost more heavily in the test on November 19 lost 34 points when the strange experimenters made the tests, and they made 46 points. The other group lost 21 points, which brought them down to 51 (fig. 1 at XX).

So we have in these rough tests a fair demonstration that we are not dependent on absolutely identical qualities, such as rhythm, accent, emphasis and tempo, for favorable results in this experiment.

Let us now follow the experiment when we were obtaining the reactions of our subjects, not to sentences primarily, but to words and sentences and to vowel and diphthongal qualities. Here we are after the element and the synthesis as nearly simultaneously as possible: words, sentences, story. But it will have to be a sketch and not a complete picture.

To give our observers the advantage of being successful, and that without too much delay, we set off with a few words that were chosen with a view to the probability of their being identified by touch with a fair degree of certainty after but little drill, and with a view also to their lending themselves to grouping later in the form of sentences. As soon as practice has bred familiarity with the tactual qualities of the

individual words and also with the sentence as a whole—its rhythm, tempo and emphasis—another sentence is added, one that is in the direction of building up a story. There is drill on the words of this sentence separately and in juxtaposition with old words. We have now (to July 8, 1925) constructed a story of fifty-eight different words. Each day there is drill on this story as a whole; on the words that enter into it separately and on vowel and diphthongal qualities that occur in these and in other words. Two or more sentences are added daily. The subjects have no cues as to what these sentences may be, except that they will answer a question that is written before them on the blackboard, and that these sentences will be composed of words drawn

TABLE 2.—*Showing Proportion of Identifications and of Confusions by the Group as a Whole: Eleven Observers, April 11 to May 19, 1925*

	A	E	I	O	U	OI	OU	ER
A 501	**235** **39.7%**	65 10.9%	21 4.5%	52 8.7%	49 8.2%	35 5.9%	41 6.9%	87 14.7%
E 497	64 12.8%	**222** **44.8%**	20 4.0%	41 8.2%	66 13.2%	16 3.2%	18 3.8%	48 9.6%
I 528	38 7.3%	30 5.6%	**200** **37.8%**	37 7.0%	22 4.1%	87 16.4%	65 12.3%	47 8.9%
O 543	46 8.4%	7 1.2%	25 4.6%	**236** **43.4%**	25 4.6%	51 9.3%	78 14.3%	72 13.2%
U 630	41 6.5%	44 6.9%	13 2.0%	44 6.9%	**337** **53.4%**	35 5.5%	50 7.9%	65 10.3%
OI 554	36 6.5%	10 1.8%	73 13.1%	46 8.3%	12 2.1%	**233** **42.0%**	87 15.7%	56 10.1%
OU 509	34 6.6%	8 1.5%	96 15.5%	38 6.3%	32 5.3%	113 18.8%	**237** **39.5%**	43 7.1%
ER 504	97 16.3%	24 4.0%	72 12.1%	75 12.6%	35 5.8%	53 8.9%	66 11.1%	**172** **28.9%**

The figures in this table mean, for example, that there were 501 reports from the whole group when A was given; 235, or 39.7% of these were correct. From the whole group there were 65 reports of E, or 10.9%, when A was given, etc.

from the story—except that now and again a new hitherto unfelt word or two are thrown in with familiar impressions to form a sentence. The purpose of this maneuver obviously is to give the subjects an opportunity for practice at filling in from the tactual context. By all these means we go a part of the way toward supplying the conditions of ordinary conversation. The participants know the subject of discourse and are able, therefore, the better to fill in the gaps and to interpret what is being said. Here we are making use of the "apperceptive mass" of the Herbartian psychologists.

The charting of returns from this investigation runs into mountainous details. It shows the relative frequency with which each subject (and all subjects together) can identify the individual words of our story by their feel. It shows the same for certain vowel and diphthongal qualities

and it demonstrates also the subjects' success in interpreting wholly new sentences that are composed of old words plus a few new ones. Furthermore, the chartings present learning curves that show the progress that each subject is making from day to day throughout the course of the experiment.

Table 2, for example, embodies the results of all exercises of all subjects in their efforts to identify certain long vowels and diphthongs and the combination *er*. Table 3 sets out the results of the effort of the most successful member of the group. The exercises occupied a brief period, from April 11 to May 19, 1925. The concentration along the diagonal spells the story of success. The scattering from the diagonal line represents the failures as a whole, and the points

TABLE 3.—*Showing Proportion of Identifications and of Confusions by the Most Successful Observer, April 11 to May 19, 1925*

	A	E	I	O	U	OI	OU	ER
A 55	**32** **58.1%**	9 16.3%	2 3.6%	3 5.4%	.. ..	.. ..	1 1.8%	8 14.5%
E 52	6 11.5%	**38** **73.0%**	2 3.8%	2 3.8%	.. ..	.. ..	1 1.9%	3 5.7%
I 52	.. ..	1 1.9%	**34** **65.3%**	5 9.6%	1 1.9%	1 1.9%	9 17.2%	1 1.9%
O 42	4 9.5%	.. ..	2 4.7%	**19** **45.2%**	.. ..	5 11.9%	4 9.5%	8 19.0%
U 61	.. ..	1 1.6%	1 1.6%	.. ..	**57** **93.4%**	1 1.6%	1 1.6%	.. ..
OI 46	.. ..	1 2.1%	10 21.7%	4 8.7%	.. ..	**22** **47.8%**	7 15.2%	2 4.3%
OU 52	.. ..	.. ..	8 15.3%	1 1.9%	.. ..	8 15.3%	**34** **65.3%**	1 1.9%
ER 52	15 28.8%	1 1.9%	5 9.6%	9 17.3%	1 1.9%	4 7.7%	2 3.8%	**15** **28.8%**

This subject gave a total of 55 reports when A was given. Of these, 32 or 58.1 per cent were correct. E was reported 9 times when A was given, etc.

of greatest confusion in particular. The ocular demonstration of the points of confusion affords an advantage to the experimenters in this enterprise, because it shows where emphasis must be placed in daily drill.

A wall chart built on the same plan as Tables 2 and 3 demonstrates with equal effect the success of our cases in identifying fifty-eight different words that occurred in the story up to July 8. The data that enter into this exposition were obtained from four observers within the space of four weeks in June and July (fig. 2). They had had tactual experience with the first two sentences of the story from May 20 to June 7. There are only nine words in the whole story with which they had tactual experience prior to the earlier date before mentioned. Because the chart is too large to be reproduced here conveniently, I am

presenting its essential features in the form of a table (Table 4). In reading this table, it should be kept in mind that as long as a given tactual impression may stand for any one of fifty-eight different words, an observer could be right by chance in his attempt at identification somewhat under two times in a hundred trials. Any margin over 2 per cent. of identifications in this case, therefore, is an indication that the observers have caught some criteria, by means of which they are able to go a longer or shorter way in the direction of making tactual discrimination among the words that compose our vocabulary—if indeed it may be called a *voc*abulary in this connection.

It is quite obvious that these words—by reason of their syllabication especially—present various degrees of ease of discrimination by touch. In scanning the figures of Table 4, some allowance must be made for this fact. Not only so, but the story grew in length in the

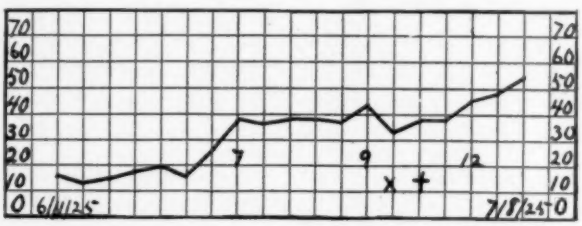


Fig. 2.—This represents the average progress of four subjects in learning to identify words by their tactual qualities alone from June 11 to July 8, 1925. Three periods of practice (one half hour each), five days weekly during four weeks. At the conclusion (from July 6 to July 8) there were fifty-eight words in the list. This is, each tactual impression might represent to the subject any one of fifty-eight words. At the beginning there were thirty different words. Nine of these had already been employed in various exercises prior to June 11. For this reason they were able to set off on that day with a good initial score (15); 7, 9, and 12 indicate additions to the vocabulary. Thus, seven words were added at the eighth session, nine at the thirteenth and twelve at the seventeenth. X = depression caused by run-down battery, + = fresh battery installed.

course of the four weeks, and some correction of the figures is due on this account. Nevertheless, the concentration along the diagonal in the word chart, similar to that in Tables 2 and 3, indicates a strong tendency toward identification, and the relative degrees of confusion illuminate the choice of stimuli for future experiments.

The curve shown in figure 2 represents the course of learning of the four subjects during the four weeks before referred to, while practicing on the story and its fifty-eight different words. The curve is based

on the identification of the individual words of the story. The formula by which its successive points were determined makes allowance for the occasional addition to the number of verbal stimuli.

Fifty per cent of identification when there are only ten possible objects for identification is one thing; 50 per cent when there are 100 objects is a very different case. The formula makes an adjustment for the difference.

TABLE 4.—*Identification of Stimulus Words by Their Tactual Characteristics* *

Stimulus Word	No. of Times Given	Percentage of Identification	Stimulus Word	No. of Times Given	Percentage of Identification
A	24	13.0	It	35	52.2
After	264	54.1	Kaercher	162	18.7
All	71	25.7	Make	101	23.6
And	136	22.9	Morning	227	23.1
Baseball	240	79.0	Mutton	158	22.9
Be	20	20.0	Nicholas	180	47.4
Braunagel	157	46.9	Of	32	12.5
Button	94	40.8	Physical	34	36.7
Circus	239	36.2	Receive	282	50.5
Contest	83	44.6	Recuperate	51	49.6
Cross-country	86	93.1	Sandwich	175	25.9
Day	61	11.5	Stiff	187	48.3
Difficult	47	50.6	Strain	36	22.2
Dollar	231	22.9	Strenuous	111	32.4
During	96	26.9	Such	170	29.5
Edward	175	42.5	The	233	33.2
Effect	36	52.7	Them	98	14.4
Enter	78	50.7	They	130	9.6
Exceedingly	132	53.1	This	31	52.7
Exercise	170	88.6	To	155	16.0
Finish	294	28.2	Today	264	29.5
Following	110	40.8	Tomorrow	240	47.0
For	205	27.2	Unusual	36	47.1
Frederick	150	14.9	Upon	88	53.1
From	17	20.0	Very	193	18.1
Game	161	12.7	Violent	218	30.0
Go	190	28.8	Week	77	7.5
Hard	186	42.0	Will	274	31.4
Hughes	176	30.0	Work	214	43.3

* The fifty-eight words are from the following extravagant practice story: "Nicholas Braunagel and Frederick Hughes will go to the circus tomorrow morning. They will work hard today for Edward Kaercher and will receive a dollar, a button and a mutton sandwich. After the circus they will go to the baseball game to finish the day. Such violent exercise will make them very stiff. During the following week all will enter upon a strenuous cross-country contest. It will be exceedingly difficult for them to recuperate from the effect of this unusual physical strain."

A percentage of identification over approximately 1.8 is an indication that the observer is making use of tactual cues as a basis for his judgments. The wide variation in the figures in the middle column is due to the fact that the story and vocabulary grew from the beginning of the four weeks session to its end.

An aggregate of twenty-five hours is a fair estimate of the total time that our observers have given to the words and sentences of the story from May 20 to June 7, and during the four weeks following June 11.

From July 8 to October 8 the processes of forgetting had full license to do their worst. Our normally equipped schoolboys in the summer months would seize with avidity on the unparalleled opportunity to forget, such as was presented to our observers subsequent to July 8. But in a test on October 8, without preparation, they showed a loss of from 25 to 75 per cent. of their records at the close of our four weeks in June and July. No so bad, compared with our classic tests of forgetting rates.

I have referred somewhat casually to our attempts at the interpretation of new sentences that had never before been felt as sentences. In this variety of enterprise, the observers have no cue as to what is coming except that they know to what subject matter the forthcoming sentence will relate; that it will answer a certain question, and that its words will be drawn almost exclusively from the tactual vocabulary that had already been built up.

In the course of four weeks in June and July, 117 such sentences were employed. From our four subjects who were at work at that time we obtained 468 reports. Of these, 225 were correct word for word. Among the remainder are 131 reports that are correct in sense, although there were errors in interpreting individual words. The total, 356, represents 76 per cent of satisfactory returns on the interpretation of sentences that had never been felt before as sentences.

This is all I can say of how good this result is because we do not know how many sentences could be built up of our fifty-eight words in various combinations. Neither do we know, when in the tactual language we throw out a question to be answered, how many variations of a correct answer could possibly be created out of the units in the vocabulary plus the occasional new word that, as I have before noted, is now and again thrown into the context of familiar terms.

Given time and patience, the second of these questions can be answered with reasonable exactness. In the meantime, I pass to a brief discussion of a problem supplementary to our exercises on individual words.

HOMOPHENOUS WORDS

One of the bugbears of the lip reader is the frequency of homophenous words in colloquial English speech. These are words that look alike on the lips of a speaker. How many such terms there are is probably not accurately known. Dr. Nitchie has published a list of 2,072 words in colloquial speech, each of which, he says, has one or more homophenes. These occur in groups of two, three, etc., upu to fourteen. During the four weeks of our last summer's work, I selected from his list 103 groups of homophenes, from two to ten words in each group. There was a total of 314 words. It was my plan to discover whether the words in each group could be distinguished one from another by means of tactual stimulation in more than a chance number of cases; for if they are truly homophenes, the lip reader can identify them only by chance. If touch surpasses lip reading as a means of identifying these words, it must be by reason of stimulus-variations that are brought to pass by the behavior of the vocal organs behind the visible moving lips.

To be assured of the homophenous character of these words as spoken by the experimenter in this relation, I ran lip reading exercises

parallel to the tactual experiments. One was to determine how accurately the words within each group could be identified by their appearance on the lips of a speaker, while the other was to discover how nicely the same words could be identified by means of touch. In the one experiment, accordingly, the experimenter sat before the subjects, with his face in their full view, and pronounced a group of words, such as "aim-ape," three times in succession—the words occurring in an order known to the subjects. This was for the sake of drill, and when it had been completed the experimenter proceeded at once to pronounce the same words in an order unknown to the observers until twenty utterances had been completed. The subjects were instructed to write down after each utterance what word they thought had been spoken. At the conclusion of this series of attempted identifications on the basis of lip reading, we checked up and proceeded at once to employ our apparatus to communicate to the skin of our observers the tactual correlates of the terms with which we had just now been busy in our lip reading test. The procedure was precisely the same as in the lip reading session. At the end of the series we checked up as before, and were then in a position to compare lip reading and touch as means of identifying the words of the group.

As a matter of fact, our lip reading test showed that only fifty from our 103 groups were composed of homophenous words. Only in relation to these fifty groups were the lip movements of the experimenter so much alike that the words could not be distinguished more frequently than chance would lead us to expect. Among these fifty groups there are three in which identification by touch is of such low frequency that it might have occurred by chance. These groups are: chair—share; pluck—plug; grease (the noun)—crease. Taking all the 131 groups together, there are only seven in which there is better identification by lip reading than by touch. When I say better and worse in these relations I am thinking of the average performance of the group of four subjects. Individual differences are in too great detail to be introduced here.

In view of all the results of our experiments to the present time, experiments that have been bent on the identification of speech forms and on the interpretation of speech as felt on the skin, I am convinced that we have demonstrated the possibility of acquiring the art of interpreting speech by means of touch cues that are communicated instrumentally from the vocal apparatus of the speaker. I do not minimize the difficulties. Our apparatus must be further improved so that tactual correlates of spoken words may be received with still greater distinctness than at present; even more difficult than this, observers must develop a memory imagery in terms of touch and in the same terms they must

learn to think. This is not an impossible condition. It is well known among psychologists that tactual imagery is distinctly subordinate to auditory and visual imagery among the people we meet from day to day. Can it be elevated to a higher place in the hierarchy—so far as our observers are concerned at least? Several memory tests we have performed answer this question in the affirmative. If it is not imagery that is being built up, it is something that behaves as imagery has been commonly supposed to do.

As I have already stated, it was a part of my program at the outset to conduct experiments relating to vocal control by the semi-mute. These subjects do not have the use of their voices in speech because they cannot hear their own voices—at any rate, this is the major cause—and consequently they are unable to guide and to correct their vocal utterance as hearing persons are repeatedly doing. As I anticipated, I have found that the semi-mute, having felt the words of the experimenter on his skin, can attempt to produce the same quality of sensation on his own skin by using his voice against the transmitter. What we are doing in this instance is to give our observers a new cue to correct speech as a substitute for hearing. In the language of the street, we are arranging the situation so that he can "get a kick" out of using his voice in speech. Our experiments in this direction have demonstrated that it is easily enough within our grasp to employ our method effectively for correcting pitch and accent and for impressing the number of syllables in a word. The subjects felt the experimenter's voice simultaneously, and they all felt, immediately after, the attempt of one of their number to produce a copy by speaking against the skin of his own hand and that of his associates in the group. For this purpose, he used a transmitter that duplicated the one employed by the experimenter.

The oscillograms (fig. 3) "A" and "B" represent the vocal performance of one of our subjects of the last summer: Number 1 in the description of subjects on a preceding page. They are an illustration of "before and after taking." The first is his performance on the word "U" (as a diphthong) at the beginning of the experiment: the second represents the same word at the end of four weeks. The indication here is at least that the pitch of his voice has been considerably lowered. The figure "B" compares very favorably with "C," which represents the writer's voice uttering the same word.

The figure "B" is from near the middle of the oscillogram, and represents the second phase of the diphthong. "A" and "C" represent a portion of each phase (ē and ōō).

I have found the tactual method a most convenient tool in relation to the correction, not of pitch solely, but of the number of syllables in a word. The superfluous syllable that so many of the deaf thrust into

the middle of such a word as "baseball" they can throw into the discard under our instrumental regimen. And there is nothing mysterious about it. Each syllable *as felt* is a distinct, concrete thing. You can point it out. The semi-mute observer knows definitely that it is there when he speaks and that it is not there when his instructor speaks. He can feel the target at which he is shooting. He knows definitely when he hits it and when he misses it. The marksman on the range, in an analogous situation, is acquainted with the advantage of seeing the target and of seeing where the bullets strike.

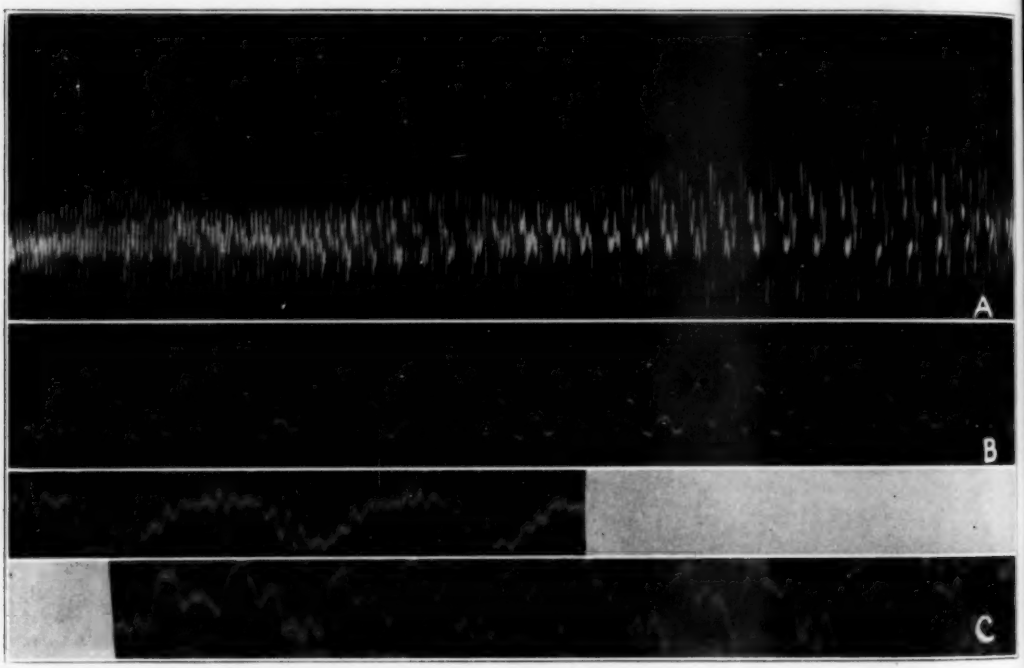


Fig. 3.—A and B represent the vocal performance of one of our subjects. The upper section of C represents the e of the diphthong u, and the lower section represents the final "oo."

CONCLUSION

In conclusion, I shall state briefly the program for future work.

1. To continue the investigation already described and along the lines I have indicated.

2. To compare the effectiveness of visual stimuli—such as are afforded by an oscilloscope—in relation to the interpretation and control of the voice in speech.

3. To discover by experiment whether touch stimuli may be a useful supplement to ordinary methods of teaching lip reading.

In rhythm, tempo, emphasis and accent, hearing people find great aid toward the interpretation of speech. By ordinary means it is difficult for a teacher to get these qualities over to a group of deaf pupils. The hypothesis is that they all can be impressed by aid of the tactual method, so that the learner at once can have advantage of them all at the same time that he is observing the lips of the speaker.

4. To discover whether tactual impressions may be the means of identifying and appreciating musical composition.

5. To develop manuals to aid teachers of the deaf to take advantage of the practical consequences of this work.

QUANTITATIVE TESTS ON BONE AND AIR ACUITY IN PARACUSIS WILLISI

REPORT OF TWO CASES, TOGETHER WITH A NOTE ON THE INTERRELATION OF AUDIOMETRIC TESTS

A. G. POHLMAN, M.D.
ST. LOUIS
AND
F. W. KRANZ, PH.D.
GENEVA, ILL.

REVIEW OF THE LITERATURE

There are several explanations of the testimony of deaf persons that they hear better in a noisy than in a quiet place. Probably the best known explanation is that put forth by Politzer,[1] who believed that the noise agitated the sound transmission apparatus and thereby made it more permeable to the accompanying sounds. Roughly in modern parlance, the noise acts like a carrier wave for sounds which would otherwise be inaudible.

Another explanation is that of Urbantschitsch,[2] who believed that the paracusis was entirely dependent on an increased efficiency in the end-organ or the central apparatus. This, he believed, was substantiated by finding that the paracusis was prolonged after the noise had ceased, and in some cases did not appear until the subject had again come into a quiet place. Objections were raised to the Urbantschitsch's findings by Siebenmann, who did not believe that the methods of testing employed were sufficiently accurate to warrant the conclusions. He reported testing a case on a railroad train with tuning forks, and found that there was no improvement. Kuemmel, himself a sufferer, believed that he did hear conversation better in a train than otherwise, but was unable to confirm his experience in listening to his watch.

We have recently located in the literature a third explanation as given by von Troeltsch,[3] in 1862. He states that the persons suffering from paracusis belong to the conduction type of deafness, in which the deficiency is most pronounced in the lower range of frequencies. They are, therefore, not so sensitive to noises as are individuals with normal hearing. Normal persons, in the presence of a noise, will unconsciously raise the intensity of their voices to rise above the level of the masking effect. This increased intensity is sufficient to enable the deaf person, not so thoroughly masked, to understand the conver-

1. Politzer: Arch. f. Ohrenh. **16**:304, 1880.
2. Urbantschitsch: Verhandl. d. deutsch. otol. Gesellsch. **21**:144, 1912.
3. Von Troeltsch: Vorlesungen, p. 254, 1862.

sation of persons with normal hearing speaking in a noisy place. In a word, deaf persons "hearing better" in a noise is dependent on normal persons not hearing so well in a noise and is, therefore, not a real phenomenon so far as the deaf person is concerned.

One of us [4] pointed out that it is in conversation with normal hearing persons that the deaf person appears to be aided by the noise. To quote from his paper:

> It seems that the determining factor in the ability of some deaf persons to converse better in a noise than otherwise, is undoubtedly the increased loudness with which a normal person talks in the presence of a noise. The normal person, of course, tries to talk so that the sound of his voice will predominate over the disturbing noise as judged by his own hearing. The actual ratio of the objective intensities of the speech and the disturbing noise striking the ear is the same for the normal and the deaf person, but, due to the difference in the acuity of the two persons, the speech sound will for the deaf person be much farther above the low limit of audition as compared with the disturbing noise than will be the case for the normal person. . . . The noise bothers the deaf person less than it does the normal person.

This explanation coincides with that of von Troeltsch, offered sixty years ago, although the existence of von Troeltsch's work was not known to Kranz when it was written last year. It is also in agreement with the observations of Siebenmann in a train, as mentioned in the foregoing. Knudsen [5] has recently published observations on several deaf subjects, which confirm this explanation.

TYPES OF DEAFNESS

It is possible that there is more than one type of paracusis Willisi. Urbantschitsch reports that he found it in three persons with normal hearing (which may be questioned); in two with chronic catarrhal middle ear infection; in two with purulent otitis media; in eight with defect of malleus and incus, and in ten with perception deafness.

The two persons we report in this paper were distinctly subjects with conduction deafness, who, in spite of the lowered acuity, particularly in the lower frequencies, spoke in a voice of low intensity. Both gave a middle ear history; both gave a negative Rinne reaction, and both were credited with prolonged bone transmission. Tests on these two patients were made at the Riverbank Laboratories with the sliding pitch audiometer designed by Kranz. The air acuity was taken with a telephone receiver which had been calibrated by comparison with a thermophone, so that the sensitivities were determined in absolute terms. However, it seems best to present the acuity in terms of the amount of deficiency from the average normal hearing, and this is done in the diagrams given. The information on the bone acuity was determined with a bone activating telephone receiver and a comparison made with the average results on normal persons.

4. Kranz, F. W.: Ann. Otol., Rhinol. & Laryngol. **33**:283 (March) 1924.
5. Knudsen: Science **52**:109 (July 31) 1925.

The air acuity of Case I is presented in Chart 1, showing the deficiency of each ear as compared with normal hearing for frequencies from 256 to 3,300 cycles per second. Thus, for the left or poorer ear, 1,000,000 times as much intensity was required for this person to hear tones from 256 to 600 cycles per second than was required for one with normal hearing. There is less deficiency at the higher frequencies than at the lower. The two ears are about of equal acuity at the lower frequencies, but for the higher part of the scale, the right ear is much the better of the two.

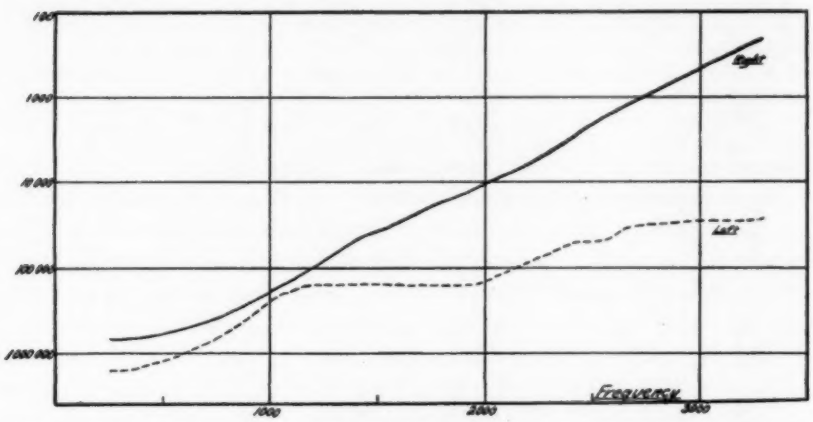


Chart 1.—Air acuity of Case 1. Deficiency as compared with normal hearing.

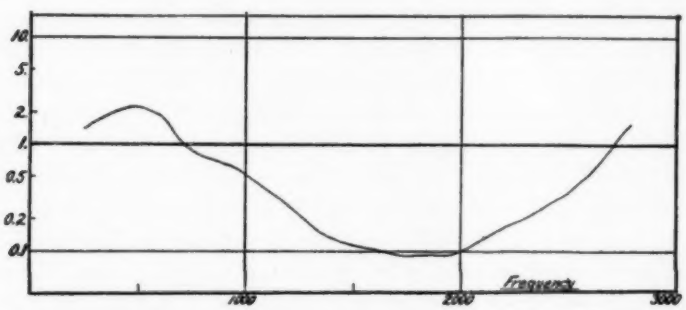


Chart 2.—Bone acuity of Case 1 compared with average normal.

Chart 2 shows the acuity for bone transmission from the forehead, compared with the average acuity of eight persons with normal hearing. The bone acuity may be classed as practically normal, because the variation from the average is no greater than that found among persons with normal hearing.

Chart 3 shows the improvement in bone acuity for Case 1, effected by occlusion of the external auditory canals with dental impression compound, and also the average improvement found in persons with

normal hearing under the same conditions. All parts of the curve above the base line mean that an improvement was experienced on occlusion of the canals, while all parts below the base line indicate that the occlusion was a detriment. The amount is indicated on the left of the chart. It will be seen that occlusion of the external auditory canals produced practically no improvement at the frequency of 1,000 periods per seconds, while below and above this frequency, there was a detriment to bone acuity. This may be compared with the large improvement in the lower frequencies plotted as the average for normal hearing people. Similar results were obtained with the water filling tests of Wheatstone. The patient reported no advantage in bone transmission due to filling the external auditory canal with water, at any of the five octave frequencies exhibited.

During the course of this experiment, an important observation was made. When the patient turned the head to one side to permit filling

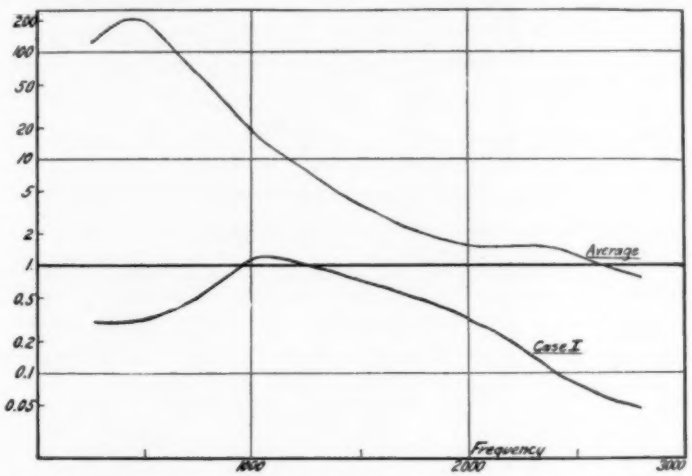


Chart 3.—Improvement in bone conduction for Case 2, due to closing of ears.

the external canal with water, she complained of tinnitus in her right ear. Filling either canal with water promptly suppressed this tinnitus. This finding in a single case has been turned over to Dr. Robert Sonnenschein for trial in all patients with intact drum membrance who complain of this difficulty. We have no definite reason as to why loading the drum membrane relieves the condition. There is, however, a possibility of its origin in a fibrillation of the stapedius muscle which might be relieved, both homolaterally and contralaterally, through weighting of the drum membrane, following the crossed and uncrossed reflex to this muscle as established by Kato. The importance of this finding, if substantiated in a number of cases, is obvious.

Summary.—There was pronouncedly decreased air acuity, particularly in the lower range of frequencies, with the left ear more defi-

cient than the right; practically normal bone acuity from the forehead and no reinforcement of bone transmission through occlusion of the external canals (the Weber-Wheatstone phenomenon was wanting).

The air acuity curves of Case 2 are shown in Chart 4. Here it will be noted that the two ears are practically symmetrical and the deafness is very marked. It takes over 100,000,000 times the minimum normal for this individual to hear 256 p. p. s. The range of best acuity is from about 1,100 to 1,700 p. p. s., and even this does not mount higher than the corresponding range for Case I. It is surprising that a person so profoundly deaf can hear anything of even a very loud conver-

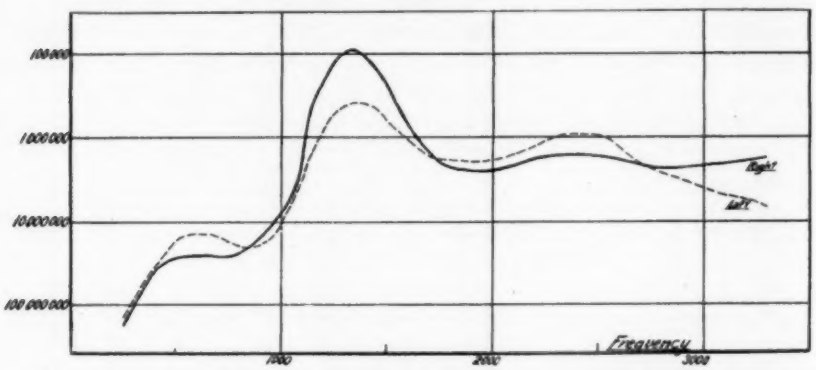


Chart 4.—Air acuity of Case 2. Deficiency as compared with normal hearing.

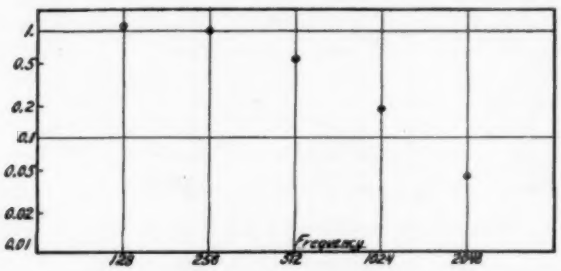


Chart 5.—Bone acuity of Case 2 in comparison with average normal.

sation. Actually, he can get along quite well, although he is noticeably deaf.

The bone acuity of Case 2 was taken at octave intervals, owing to the limited time available for testing. The results are given in Chart 5 compared with the average acuity of eight normal persons, as was done in Case 1. It will be seen that the bone acuity is, in general, quite close to the average. In fact, for the four lower frequencies, this subject is closer to the average bone acuity than is any single normal person tested. At 2,048 p. p. s., his difference from the average is but slightly greater than that found in some of the normal persons. On occlusion of

the external auditory canals with dental impression compound, no effect at all on bone acuity was obtained for four of the five octave frequencies tried, while at 512 p. p. s., a decrease of about a factor of 15 was found. Therefore, occlusion may be said to have a negligible effect. The average effect on normal persons is shown in Chart 3.

No water filling test was made on this subject, but the bone acuity for tuning forks was tested in comparison with a normal hearing individual. The results were found to be dependent on the conditions under which the tests were made, as will be described later in this paper.

Summary.—This patient was profoundly deaf throughout the entire frequency range; there was somewhat better acuity from 1,100 to 1,700 p. p. s. than elsewhere; the bone acuity was quite normal and the Weber-Wheatstone phenomenon was wanting.

ACOUSTIC INSULATION

Our investigations on acuity for bone transmitted sounds have established the remarkable acoustic insulation of the labyrinth in persons with normal hearing. There is another possibility which suggests itself. The person may be suffering from otosclerosis, and the otosclerotic changes around the otic capsule may have reduced the normal insulation, so that the vibrations passing through the temporal bone may effect the end-organ direct on account of these changes. This would imply that the bone transmission in both of these cases might be through an abnormal route.

The condition of paracusis Willisi in these cases appears to be closely associated with (1) a negative Rinne reaction; (2) a so-called prolonged bone transmission, and (3) the speaking in a voice of low intensity.

At our suggestion, one patient (Case 1) was requested to observe whether the stopping signal in a street car was heard more plainly while the car was in motion or after it had stopped. She reported that the noise of the car in motion was of no assistance in hearing the signal. These two patients (Cases 1 and 2) were also placed back to back in a room with a considerable noise under control, and were asked to converse with each other. They reported no appreciable difference in their ease of conversation under the two conditions of noise and quiet. This is in accord with the statement given in the foregoing, namely, that deaf people do not actually hear better in a noise.

PROLONGED BONE TRANSMISSION

Both of these cases are listed as having a prolonged bone transmission. Prolonged bone transmission, as the term is used, means that a given individual hears a vibrating fork by bone transmission longer than does the examining physician himself. Tests of this kind are

invariably conducted in an office which is not quiet, but in which there is always more or less of a noise. Under these conditions, the deaf person enjoys an advantage similar to that which he has for conversation in the presence of a disturbing noise; that is, due to his deficient acuity for the lower frequencies, he is less interfered with by adventitious noises in the bone transmission tests than is the physician with normal hearing who is conducting the tests. This difference between the two observers would probably be quite different, disappear or reverse if the test were conducted in a deadened room with the external noises excluded. A test of the bone acuity with tuning forks was made on one patient (Case 2), in comparison with the normal hearing person who had been found to have the best bone acuity of our control cases. A comparison was made between the lengths of time each of the two individuals heard a fork, the stem being placed on the top of the head. Trials were first made in a quiet place, and then in a room with a 16-inch electric fan in operation at full speed. The noise in the second room was not very great, as the room was effectively deadened with felt. One patient (Case 2) was not certain that he heard the noise of the fan. Three forks of 128, 192 and 320 double vibrations per second were used. Under the quiet conditions, the person with normal hearing heard these forks longer than did the other patient (Case 2), by 4, 15 and 10 seconds, respectively. But in the presence of the noise, this patient (Case 2) heard the forks longer than did the person with normal hearing, by 6, 20 and 10 seconds, respectively. This difference is entirely dependent on the slight amount of adventitious noise. If only the latter test had been made, we would have agreed with the finding that the patient in Case 2 had prolonged bone transmission. Hence, one may conclude that prolonged bone transmission, as usually reported, means only a lowered air acuity for the lower frequencies and nothing more. The call is being made for a standardization of the various forks used by otologists, so that the results of tests made by them may be more readily compared. As a matter of fact the forks themselves are probably more uniform, and not the cause of any more variation in results than the conditions under which the tests are conducted.

The negative Rinne result may also be a consequence of the deficiency in air acuity. If the acuity for air transmitted sounds is lowered while the bone acuity is practically normal, the subject will hear the fork relatively longer by bone transmission than by air transmission when compared with an individual of normal hearing.

A normal person, under the usual conditions, experiences a certain amount of masking due to the background of prevalent noise. This background of noise is subjectively greatly reduced in persons of lowered air acuity. The lowered air acuity also causes a subject with good bone acuity to judge the intensity of his voice through bone trans-

mission, as opposed to the normal person who judges the intensity of his voice through air transmission. This type of deaf person will, therefore, tend to speak in a voice of the same intensity in a noisy place as that used under conditions of quiet, as opposed to another type of deafness in which the person shouts to hear himself.

COMMENT

The four symptoms displayed in these two cases appear to be quite commonly associated, and all seem to be due to the same general cause. The lowered air acuity with practically normal bone transmission may produce paracusis Willisi, the negative Rinne reaction, the so-called prolonged bone transmission and the speaking in a voice of low intensity. This lowered air acuity in both ears for the lower frequencies, which are characteristic of most noises, is due largely to mechanical interferences in the sound transmission system; while the excellent bone transmission demonstrates the end-organ to be in good condition, even if the route selected for bone transmission is shown to be an abnormal one.

THE ALTERNATING WEBER TEST AND A NEW METHOD OF DETERMINING WEBER LATERALIZATION IN DOUBTFUL CASES

DOUGLAS MACFARLAN, M.D.

PHILADELPHIA

Aurists who have taken an acute interest in hearing tests and in their analysis are convinced that most of the tests cannot be considered singly as the sole criterion for a diagnosis. Thus the deductions from the findings in one test must be made only after collecting the data from the others. Findings will, of course, suggest the pathology present, and, vice versa, the pathology diagnosed should explain the test findings. For example, it has long been recognized that the Weber lateralization must be valued in the light of the following possibilities, namely, mixed deafness, unilateral or bilateral, and bilateral deafness of the same or of different types. It can nearly always be predicted what the Weber test will be if each ear is first tested for air conduction and bone conduction independently. For any testing instrument with which it is possible to make the Weber test, the sound will always be referred to the ear showing the greatest bone conduction. The sole exception to this rule is found in the Weber-Schwabach paradox, which will be explained later.

The cases here cited lead me to add a new corollary to the foregoing rule for the analysis of Weber findings. Occasionally, when using the Weber test in different pitches, it may be found that the hearing is referred to one side with one pitch, and to the opposite side with a different pitch. Considering the individual ear, this means that in one part of the range, air conduction and bone conduction may have an entirely different relation than what they have in another.

In these cases I have made the tuning fork tests with a König 488 double vibration fork. This is struck with a swinging pendulum which gives a dependable blow. (The pendulum is a short brass rod about 8 inches long, one end is covered with a piece of rubber tubing; the other is perforated to allow the rod to be suspended on a nail.) The normal time for hearing the fork is thirty seconds for bone conduction; sixty seconds for air conduction. The hearing for high tones is tested with a Struychen-Schaeffer monochord, the only instrument that can test both bone and air conduction and in the upper limits. As to the technic of taking the Weber test in these cases, the vibrating instruments (fork or monochord) in each instance are placed on the brow in the mid-line.

Patients with bilateral involvement in which bone conduction is equal on both sides show that the Weber test is usually referred to the side having the better air conduction.

REPORT OF CASES

CASE 1.—Miss A., aged 50, had a bilateral mixed deafness of long standing. The findings, with a tuning fork of 488 double vibrations, are given in Table 1.

TABLE 1.—*Findings in Case 1*

	Monochord (Upper Hearing Limit)	Galton Whistle
Right ear:		
Air conduction 30:60	12,000	1.5
Bone conduction 0:30	19,000	
Left ear:		
Air conduction 43:60	13,000	1.7
Bone conduction 25:30	12,000	
Weber left	Weber right	

CASE 2.—A. A. T., aged 45, had atrophic rhinitis and otitis of long standing; the Wassermann test was negative.

TABLE 2.—*Findings in Case 2*

	Monochord	Galton Whistle
Right ear:		
Air conduction 35:60	14,000	0.2
Bone conduction 28:30	20,000	
Left ear:		
Air conduction 55:60	16,000	0.1
Bone conduction 17:30	21,000	
Weber right	Weber left	

CASE 3.—A. F., aged 41, had sudden deafness, which appeared two weeks prior to examination, the cause of which was unknown; there had been no previous trouble; the drums were normal; the tubes were patent and the Wassermann test was negative.

TABLE 3.—*Findings in Case 3*

	Monochord	Galton Whistle
Right ear:		
Air conduction 40:60	15,000	0.4
Bone conduction 30:30	16,000	
Left ear:		
Air conduction 30:60	18,000	0.4
Bone conduction 25:30	22,000	
Weber right	Weber left	

CASE 4.—Mrs. L., aged 54, had hereditary nerve deafness; the drums were normal.

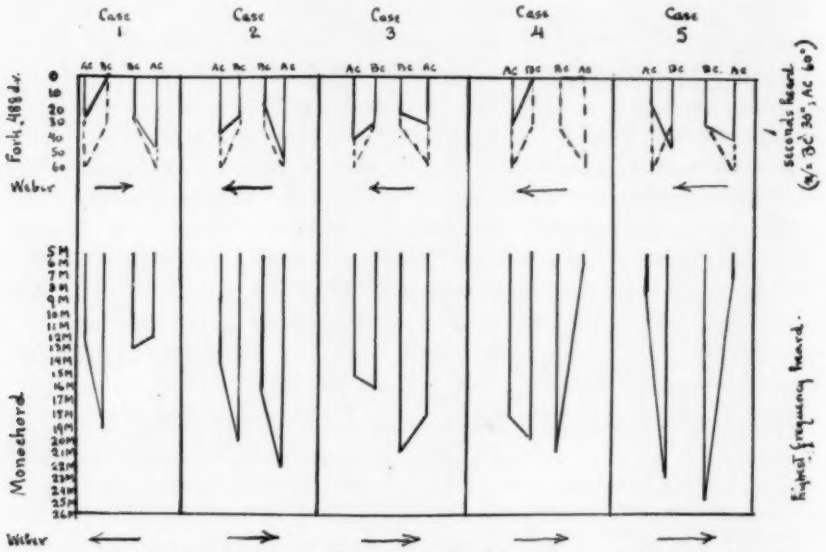
TABLE 4.—*Findings in Case 4*

	Monochord	Galton Whistle
Right ear:		
Air conduction 20:60	18,000	0.4
Bone conduction 0:30	20,000	
Left ear:		
Air conduction 0:60	6,000	1.0
Bone conduction 0:30	21,000	
Weber right	Weber left	

CASE 5.—D. K. R., aged 49, had bilateral otitis media purulenta since an attack of typhoid fever in childhood; the drums were badly damaged, the ears were dry.

TABLE 5.—*Findings in Case 5*

	Monochord	Galton Whistle
Right ear:		
Air conduction 15:60	8,000	2.4
Bone conduction 42:30	23,000	
Left ear:		
Air conduction 32:60	10,000	2.2
Bone conduction 30:30	25,000	
Weber right	Weber left	



Cases illustrating the alteration of the Weber test at different pitches.

A knowledge of this variability of the Weber test will clear up the confusion that an examiner might have in running across such findings. It will be noted that in every instance the greater bone conduction is on the side to which the Weber test is referred. The rationality of the finding is obvious.

THE WEBER-SCHWABACH PARADOX

There is one contradiction to the before-mentioned rule. In patients with acute ear congestion (in the prodromal or active stages of acute middle ear suppuration), the Weber-Schwabach paradox appears. This valuable sign, discovered by MacKenzie, shows a Weber test referred to the diseased side, but a shorter hearing time for bone-conduction-hearing with the fork on the mastoid antrum of the diseased side than when the fork is on the antrum of the healthy side. MacKenzie states that this sign appears in all acute mastoid cases;

this finding was confirmed by Patterson and myself. The sign only appears in catarrhal, never in nerve deafness. The obvious explanation of the phenomenon is that acute congestion and inflammation of the mastoid cause a reduction in the resonance to bone conduction when the fork is held against the antrum, whereas the resonance caused by a vibrating fork placed on the brow is not affected.

THE NEW METHOD

In children, or in ignorant adults, we often find it impossible to obtain a report on the lateralization of the sound. It is true that when the hearing in both ears is equal, the sound is not lateralized, but is referred to the whole head. The intelligent patient may report: "I cannot tell in which ear the sound is louder; it sounds equally loud in each." But when we find a patient in whom we know we should find a definitely referred Weber test, we may get an unsatisfactory, uncertain reply. The ignorant patient may simply insist on reporting tactile sensation for hearing. It is in such cases that I cease asking the patient where the sound is loudest. I put a diagnostic tube in each ear of the patient and put the opposite ends of the tubes in my own ears. Then the sounding fork or the monochord is placed against the patient's brow; the ear to which the Weber test should be referred disperses a louder tone to its auscultation tube and thus to the corresponding ear of the examiner.

With more inconvenience to the patient the auscultation can be performed via the eustachian tube mouths, using tubes attached to catheters.

COMMENT AND CONCLUSION

It is obviously essential that before such testing can be considered of any value, the examiner's hearing must be normal. Further, it is natural that certain observers will be able to distinguish differences in intensity better than others. The test serves as a check on the Weber test as usually taken, and as a check on air and bone conduction as independently taken. It eliminates the subjective element. It is excellent in testing children or ignorant adults who cannot discriminate between tactile and auditory senses.

1805 Chestnut Street.

UNUSUAL TYPES OF MASTOIDITIS

JOSEPH I. KEMLER, M.D.
BALTIMORE

Acute mastoiditis may be primary or secondary. Primary mastoiditis is rarely encountered and is generally due to tuberculosis, syphilis or trauma. According to Kerrison,[1] the mastoid process seems to be immune from acute diseases.

The mastoiditis seen in daily practice is usually secondary to a diseased middle ear. It is natural for middle ear affections to involve the mastoid, since the mastoid always contains an antrum and at least a few cells lined by mucous membrane continuous from the middle ear; it is an accessory sinus to the middle ear which, in turn, is accessory to the nasopharynx. Primary mastoiditis of unknown origin has been reported from time to time, and a survey of the literature reveals about fifty-five cases reported. In none of these is it definitely proved that the middle ear was not involved, yet the cases are unusual because there was no discharge or inflammation in the middle ear at the time of operation on the mastoid. The following case from my own observation, is typical.

REPORT OF CASE

CASE 1.—*History.*—A. B., a boy, aged 6 years, had a rather mild attack of grip in January, 1925, which soon cleared up. Ten days later, pain developed in the right ear, which was treated with irrigations and cold applications. There was no discharge whatever, according to the statement of the family; the pain was very slight while the patient was lying down, but severe when he raised his head, and of an intermittent character, coming on chiefly at night so that he slept little. There was but a slight elevation of temperature. The patient had never been ill previous to this attack.

I saw the patient first on February 4, three weeks after the onset of the ear attack, and at that time he apparently was not suffering.

Examination.—The boy was of normal size and development. The tonsils and adenoids were small and with no acute inflammation; the nose was clear, and the breathing was good.

The left ear was normal; in the right ear the auricle could easily be moved without pain. There was a slight swelling over the mastoid, chiefly next to the auricle. The posterior fold was still present. The only tenderness discernible was just below the tip. The canal was closed by a diffuse swelling with no particular furuncle to be made out. The introduction of the smallest speculum was painful but not so severe as in furunculosis. The inner half of the canal was found to be not quite as swollen as the other half. Just a glimpse of the drum membrane could be had, which appeared normal. No reduction in hearing was made out. The temperature was 100 F. A wick of ichthyol ointment was introduced and an ice bag was applied to the mastoid.

February 6: The patient had spent very good nights and felt much better. The external appearances were unchanged, but the canal was more open and more of the membrane could be seen, which was found to be quite normal. The treatment was continued.

---

1. Kerrison, F. D.: Diseases of the Ear, Ed. 2, Philadelphia, 1921, p. 181.

The patient had two poor nights, from February 6 to 8. The canal was more widely open. The drum membrane was obstructed by a bulging in the posterior wall of the canal and about 1 cm. in front of it. Paracentesis in this bulging revealed bloody discharge after using suction.

Six hours later, a profuse discharge began from the right ear and at the same time a swelling appeared below the tip of the mastoid. It was decided that an operation was necessary.

At operation, which was performed in the usual way, the periosteum of the posterior part of the canal was found to be perforated near its attachment to the auricle, the skin was deficient in the corresponding place, and pus was discharging through these openings. The rest of the cortex was hard and in good condition. The cell walls had been destroyed and the lateral sinus was exposed for about three-quarters of an inch in the center of its vertical portion. The entire tip was necrosed and lying as a sequestrum bathed in pus, forming a so-called Bezold's abscess. All the débris was cleaned out and the wound was packed.

Postoperative Course.—The patient made an uneventful recovery and was discharged as cured three weeks after the operation.

The operative findings in this case explain the slight tenderness over the mastoid, the extreme narrowing in the canal, the swelling and tenderness below the tip, and the sudden profuse discharge just prior to the operation; but they do not explain the origin of the mastoiditis.

Mastoiditis may be the result of a middle ear infection traveling through its natural channel, the aditus ad antrum, which becoming constricted allowed the mastoid process to suppurate and the middle ear to clear up completely. So far as is known in the case reported, there were no signs of any middle ear infection either before or after the operation.

Le Mee [2] and Rendu,[3] and other French writers describe a condition found in infants and young children known as latent otitis media that may be complicated by mastoiditis with, however, the classical symptoms lacking. Patients complain of little pain, discomfort, fulness or impaired hearing. The drumhead may be full, sometimes even bulging and without luster, and paracentesis always reveals pus. In Case 1 the tympanic membrane was perfectly normal, so that latent otitis media cannot be regarded as being present.

A condition rather serious in nature and much stressed by the Viennese school is thoroughly described by Kettlekamp.[4] He says that the onset is insidious, with symptoms so slight that they may be unnoticed by the patient until serious complications develop. Few signs of inflammation in the drum membrane may appear and paracentesis will reveal no discharge; the hearing is not reduced until rather late in the progress of the disease. Usually, there is little or no tenderness over the mastoid, but on opening one is amazed at the extent of the

2. Le Mee: Ann. d. mal. de l'oreille, du larynx, etc. **42**:400, 1923.
3. Rendu, C. R.: Congress d'Otologie, Paris, July, 1922.
4. Kettlekamp, F. O.: Laryngoscope **34**:44-50 (Jan.) 1924.

destruction. The organism found is invariably *Streptococcus mucosis capsulatis,* and the capsular substance is believed to destroy bone without signs of inflammation. The clinical picture of the case reported is not unlike *mucosis otitis,* but repeated cultures showed only streptococcus.

There remains then for consideration a primary mastoiditis or a mastoiditis without apparent involvement of the middle ear. Hempstead [5] differentiates between the two, since it is possible for the middle ear to have caused the infection, although at the time of mastoidectomy it might no longer be involved, as explained here. This condition, however, is rare compared with mastoiditis with involvement of the middle ear. The proportion was three in 500 cases at the Mayo Clinic.[5] Our case may be classed with the rare occurrences, as there was a history of a preceding grip, which frequently leads to ear trouble in children.

Primary mastoiditis is always a blood-borne infection. Like osteomyelitis of the other bones it may occur after severe local injury. I have seen such a case recently, which is here reported.

CASE 2.—C. D., a boy, aged 18 months, fell on his head striking the right mastoid. He complained little, slept well, and ate and played normally, but allowed no one to touch the mastoid region. Five days after the accident the parents noticed a swelling over the mastoid and called in medical advice.

Examination.—The posterior auricular fold was obliterated, typical of mastoiditis. Except for a slight fulness the drum membrane looked quite normal; all details were clearly seen. A paracentesis revealed no discharge, nor did any appear later. An operation was decided on.

Operation.—The tegument was incised in the usual way and the periosteum was found to be very much inflamed. Just below the antrum, there was a round perforation about 5 mm. in diameter. The entire mastoid was cleaned out with a curet and the cavity was packed, as in any ordinary mastoidectomy.

Postoperative Course.—The patient had no reaction whatever, and was discharged the day after the operation in care of his father, a physician. This case was true primary mastoiditis.

COMMENT

Both cases are unusual, as they present a mastoiditis without involvement of the middle ear, a primary mastoiditis.

Case 1 is of additional interest because of the presence of a beginning Bezold's abscess, a rather infrequent occurrence and worth mentioning. It also shows the necessity, and, at times, the difficulty of differentiating between external otitis and mastoiditis.

---

5. Hempstead, B. E.: Mastoiditis Without Apparent Involvement of the Middle Ear, J. A. M. A. **81**:1266-1270 (Oct. 13) 1923.

MENINGOCOCCIC MASTOIDITIS

O. JASON DIXON, M.D.
KANSAS CITY, MO.

Meningitis as a complication of acute ear infections is looked on as the common fatal outcome of such a disease, and, when recognized, all hope and treatment are abandoned.

The case reported here demonstrates the possibility of epidemic cerebrospinal meningitis as a complication of mastoiditis, and the subsequent lack of proper treatment owing to failure in recognizing the type of meningitis.

REPORT OF CASE

History.—A boy, aged 12, in a very sick condition, was brought to St. Margaret's Hospital, on Jan. 25, 1922, from a neighboring town.

During Christmas week he had complained of an earache in the right ear, which became progressively worse. Because of sleeplessness, he was taken to his family physician, who punctured the drum with a long needle. This gave the patient no relief. He was then taken to a "specialist" the following day in a nearby town, who incised the ear drum and took out the tonsils and adenoids. The temperature remained high (103 F.) but the boy obtained relief from the earache, as the ear began to drain, and he was taken home.

Within four days his parents noticed that he had a stiff neck, and that his right ear was tender and painful over the mastoid process. Three days later, the pain was localized over the frontal and occipital region, where it remained to the time of examination. The patient also complained of pain over the sternoclavicular articulation of the left clavicle. For three weeks his temperature ranged between 101 and 104 F. The pulse remained between 50 and 60. He had several sudden explosive vomiting attacks and was very sleepy. While asleep, he was bothered with terrifying dreams. He had had no chills. There had only been two bowel movements since January 7, and the patient had difficulty in urinating. The light hurt his eyes, and he had considerable vertigo and diplopia.

Examination.—A pale, thin boy with a drawn face and squinting half closed eyes was seen. He was drowsy, extremely irritable and cried easily. He answered questions slowly but accurately, and gave no evidence of any unusual mental disorder.

From the right ear a thick, yellow purulent discharge was exuding. The mastoid was tender only at the tip, but was not swollen. There was a marked sagging of the superior canal wall which extended into the superior quadrant of a red bulging drum; pus was coming from a small irregular perforation near the base. The patient did not hear with this ear. The left ear was normal.

There was no scalp tenderness, and although the neck was stiff and sore, the boy moved his head freely. At the left sternoclavicular joint was a red tender area the size of a walnut, which apparently contained pus.

Urinalysis at this time was negative. There were 3,600,000 red blood cells, 26,200 white blood cells, and 85 per cent. polymorphonuclears. The spinal fluid was under increased pressure and turbid, with 2,700 polymorphonuclears per cubic centimeter. A careful search of centrifuged smears disclosed no bacteria. The Wassermann reaction of the spinal fluid was negative.

Neurologic examination by Dr. E. T. Gibson revealed normal reacting pupils without gross defect in the eye movements, except a slow lateral nystagmus. The disks were slightly blurred on the nasal borders. The tendon

reflexes were about normal. Babinski and Oppenheim reactions were negative; there was a positive bilateral Kernig sign. The neck tendons were stiff and prominent. The roentgenogram showed involvement of the right mastoid.

Due to the negative bacterial flora in the spinal fluid, it was thought that an exploratory mastoidectomy might reveal an extradural abscess in the middle fossa.

At operation, a badly infected mastoid was found, and the dura of the middle fossa, while acutely red and inflamed, did not reveal any abscess formation.

The patient stood the operation well and made considerable improvement, probably on account of the decompression. Within forty-eight hours the temperature rose to 106 F., and the boy died.

Necropsy revealed purulent basilar meningitis, which on smear and culture proved to be gram negative intracellular diplococci.

The culture taken from the mastoid at the time of operation also revealed gram negative intracellular diplococci, with the same characteristics as that found at necropsy. A twenty-four hour culture of the spinal fluid showed the same organisms.

There was no evidence of any pathway of infection extending from the nasal accessory sinuses or from the ear.

COMMENT

Obviously, the patient was suffering from meningococcic mastoiditis, in addition to the cerebrospinal meningitis. Just what part the tonsillectomy and adenoidectomy played in this complication, I cannot say. At any rate, it was very bad surgery.

There were no other cases of epidemic cerebrospinal meningitis in the neighborhood.

As the meningococcus is a frequent inhabitant of the nose, I am inclined to believe that the virulent organisms were present at the time the nose and throat operation was performed, and were incited to grow by this procedure.

While the child was in a desperate condition at the time of operation, it is not fair to say that he might not have responded to proper treatment.

Epidemic meningitis offers a fair chance of recovery when treated early and properly. While extremely unusual, meningococcic meningitis as a complication of mastoiditis should always be considered.

917 Rialto Building.

Clinical Note

THE NASAL GANGLION

OBSERVATIONS CONCERNING VERTIGO, PARAGEUSIA AND GLOSSODYNIA. CASE REPORT

SIMON L. RUSKIN, M.D.
NEW YORK

My attention was first called to this syndrome by an observation made on a patient suffering from hay fever and asthma of nasal origin, to whom I gave a nasal ganglion injection by the posterior palatine (palatomaxillary) canal route, which I described in the February, 1925, issue of the *Laryngoscope*. For a few weeks following the injection, the patient complained of a disturbance of taste on the injected side. In tracing the possible cause, I found that the sensory root of the facial nerve, the nervus intermedius of Wrisberg, which supplies the greater superficial petrosal nerve to the nasal ganglion, possesses taste fibers. These taste fibers probably pass from the nasal ganglion, along with the anterior middle and posterior palatine nerves through the palatomaxillary canal, to the roof of the mouth and faucies, and from there to the tongue.

CASE REPORT

Shortly after this observation, Mr. J. K., a silk merchant, aged 63, was referred to me by Dr. N. Gordon. The patient complained of a bitter taste on the left side of his mouth, which began twenty-one months before as a salty taste and changing in a few months to a bitter taste. He suffered also from a burning pain along the left side of the tongue, most severe at the tip. Since the onset of this complaint, he has had severe attacks of dizziness every two or three weeks, necessitating his going to bed for one to three days. The attacks of vertigo were frequently associated with nausea and vomiting. The character of the vertigo he described as rotatory and at times it would be a sensation of falling away from the objects he saw. In cold weather he suffered from rhinorrhea and slight pain in the left maxillary region.

Nasal examination revealed a bilateral ethmoiditis, otherwise the findings were negative. The patient had had a left ethmoidectomy performed one year prior to his coming to me. During the two years of his complaint, he had had almost every conceivable form of treatment with little or no relief. Because of his age, the vertigo had been attributed to arteriosclerosis and his taste sensation to gastric disturbance.

The presence of the ethmoiditis led me to cocainize the left nasal ganglion. This application was followed by immediate relief from the bitter taste and burning of the tongue. These symptoms recurred in a few days but were the mildest since the onset of the condition. I then injected the nasal ganglion by the palatomaxillary canal route. This was followed by marked relief in the symptoms. Prior to these treatments, the patient had been obliged to wake up four or five times during the night to rinse his mouth with caustic washes, so annoying was the bitter taste. Since the treatment he is awakened either once a night or not at all. A slight amount of the burning and bitterness in the mouth remained after the first injection. He received three subsequent injections, with complete relief finally. Since the first injection he remained free from the vertigo, with the exception of two very mild attacks lasting for a few minutes.

Vertigo I have found a frequent complaint in association with nasal ganglion neuralgia. The relief is immediate if the application is made during an attack. The probable route of the irritation causing the vertigo is through the small branch leaving the facial nerve at the internal auditory meatus and communicating with the eighth nerve.

Similar observations have been recorded by Sluder and Dean. This is, however, the first patient in whom these symptoms were satisfactorily relieved by the alcohol injection of the nasal ganglion through the simple and easily performed palatomaxillary canal route, which I have suggested in previous publications.

351 West 86th Street.

PROGRESS IN OTOLARYNGOLOGY

A Summary of the Bibliographic Material Available in the Field of Otolaryngology

---

ANATOMY AND PHYSIOLOGY OF THE EAR

REVIEW OF THE LITERATURE FROM SEPTEMBER, 1924 TO OCTOBER, 1925

PHILIP E. MELTZER, M.D.
BOSTON

This review practically narrows itself down to the recent studies on the labyrinth. Gross anatomic and histologic studies of the ear have been few, in comparison with those in physiology. This evidently is so because the labyrinth lends itself readily to experimental purposes, particularly in animals. While the conclusions obtained from this form of experimentation are not applicable entirely in man, they are sufficiently accurate to be compared. The basis for the theories regarding the labyrinth, and the methods used for testing the same, have been derived from this experimental work, and the information of the future will be derived mainly from this source, though tempered by clinical data.

For many years, interest was centered about the semicircular canals, and the disturbances of equilibrium were associated chiefly with this structure. Though the otolith organs were mentioned from time to time by the earlier investigators, the full significance of their function was not entirely conceived. The recent stimulus given to otologists concerning the reactions and reflexes of this organ, is mainly due to the masterly and accomplished investigations of Professor Magnus, of Dr. deKleyn and of their associates. One must add the name of Professor Quix, who has also contributed extensively to the literature information of inestimable value concerning this structure.

To otologists, the question arises as to the practicability of application and clinical significance of this experimental work. The literature describing this work is technical, therefore not easily followed or understood by the average otologist. This probably accounts for the tendency to learn by rule the reactions obtained from the labyrinth in health or in disease, rather than by the understanding of the physiologic basis underlying them.

However, one thing is evident and seems to be an established fact; that is, the attributing to the otolithic apparatus a definite function and its importance in the maintenance of equilibrium. Not all the

workers are in agreement in their findings, and considerable contradictory evidence is frequently found, but, in the main, they seem to agree.

GROSS ANATOMY

Little has been added to the existing knowledge of the gross anatomy of the ear during the last year. Radiologists (roentgenologists) have reported and elaborated on the arrangement of cells in the mastoid process, with abnormal extensions into the parts bounding the middle ear, classifying mastoids into types which may, by the arrangement of cells, predispose to mastoiditis or give rise to complications from mastoiditis.

Cheatle [1] describes anatomic types of mastoid cell arrangement which he considers conducive to osteomyelitis. He further describes a specimen in which there is complete absence of the descending part of the lateral sinus, its place being taken by the mastoid emissary vein nearly one-half inch in diameter, and remarks about its surgical significance.

Cheatle [2] considers the mastoid emissary vein of such surgical importance that he describes its anatomic variations in detail in a later article. It is the remains of the primitive jugular, and as it is a vestigeal relic, it is subject to great variation in the human skull. It may or may not be present always. Its size varies from a mere thread to three-eighths of an inch in diameter. The canal for the vein is never surrounded by cells. It may be short, one-eighth of an inch in length to as much as three-fourths of an inch, and its course is variable. The exit may be far back on the skull, reaching the masto-occipital suture or even beyond it. It may be as low as the digastric fossa.

Shea,[3] in describing the morphology of the mastoid, stresses the surgical value of such knowledge when dealing with infections involving this structure. The cells forming the tip arise from the hypotympanic space, while the remainder of the mastoid cells arise from the antrum. It is quite possible from this arrangement to have one group of cells pneumatic in type, the other acellular. The acellular mastoid he considers the dangerous variety. In this respect he is in agreement with Cheatle.

Hoffman [4] presents two unusual anatomic conditions of the temporal bone, one in which there is absence of the nerve to the posterior ampulla, the special sensory epithelium of the cristae being replaced by simple cylindric epithelium; the other being a case of extreme lack of development of the left sigmoid sinus and the internal jugular vein.

---

1. Cheatle, Arthur: Acta Oto-Laryngol. **8**:117, 1925.
2. Cheatle, Arthur: J. Laryngol. & Otol. **40**:633, 1925.
3. Shea, J. J.: South. M. J. **18**:53-55 (Jan.) 1925.
4. Hoffman, Lothar: Monatsch. f. Ohrenh. **4**:402, 1925.

HISTOLOGIC AND COMPARATIVE

Benjamins,[5] examining the membranous labyrinth of the pike, discovered what he believed to be a new peripheral network in the vestibular organ. This network of nerve filaments was noticed in the peripheral part of the wall of the otolith sacs, and the supposition is that it has nothing to do with sense function and may be considered as a secretory nerve fiber belonging to the autonomic system.

Solovcov's [6] investigations were conducted on fresh cadavers of children. He warns that sections intended for examination should be carefully prepared before being placed in fixing solution. All superfluous bones must be removed, the membranous labyrinth laid free over as great an extent as possible, and the preparation introduced into a 10 per cent solution of formaldehyde. Following completion of fixation, the bones which remain are removed, together with the lamina spiralis ossea, the spiral ligament, and Reissner's membrane, so that only the basilar membrane, the crista spiralis, and Corti's organ are left. This portion alone is stained in accordance with Bielschowsky's method.

In connection with his article, Colovcov presents reproductions of three photographs of histologic preparations on which he bases a schematic representation of the various forms of termini of the eighth nerve.

With respect to the question as to whether the nerve fibers only surround the auditory cells or penetrate into the protoplasm of the latter, Solovcov is of the opinion that this cannot be decided with the aid of staining methods thus far employed by him. However, he encountered a few cells in which nerve fibers penetrated directly into the protoplasm.

Fischer [7] instituted a number of anatomic and histologic investigations of the spiral ligament in birds and in mammals as well as in the human subject. He found only slight variations of structure in animals, and, in consequence, concluded that the ligament possesses a certain physiologic importance.

A demonstration of the possibilities of distinction between variation and artificial production in the interpretation of the conserved preparation is presented by Fischer.

PHYSIOLOGY OF LABYRINTH

Magnus [8] gives an excellent account of the work, done in Utrecht, used as a basis for his theories on vestibular function. He unhesitatingly acknowledges the work of previous investigators, and uses their

5. Benjamins, C. E.: Acta Oto-Laryngol. **8**:60, 1925.
6. Solovcov, N.: Cas. lék. ces. **64**:241-244 (Feb. 14) 1925.
7. Fischer, J.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **11**:1-9, 1925.
8. Magnus, R.: J. Laryngol. & Otol. **39**:677, 1924.

hypotheses as a foundation for his own. In the last fifteen years, many experiments were conducted on the reflexes connected with posture and attitude, with righting function and distribution of muscle tone, and on the rôle played in these functions by different sense organs, especially by the labyrinths. The following groups of reflexes arising from the labyrinth and absent after labyrinthine extirpation, were studied.

Groups of Reflexes Absent After Labyrinthine Extirpation

Group 1. Reflexes responding to movements:

1. Rotary reactions: (a) on head, (b) on eyes, (c) on limbs, (d) on trunk — Apparatus of semicircular canals. Otolithic apparatus may also be stimulated by movements.

Group 2. Reflexes resulting from position:

	Otolithic apparatus
1. Tonic labyrinth reflexes on the body musculature	
(a) on limbs	utricle
(b) on neck (and trunk)	utricle
2. Labyrinth "righting" reflexes	
(a) asymmetrical	saccule
(b) symmetrical	utricle
3. Compensatory eye positions	
* (a) vertical	saccule
(b) rotary	?

* In rabbits and guinea-pigs, but in monkey and man (a) and (b) must be exchanged.

Group 1 reflexes are transient and are evoked by movements, while in Group 2, the reflexes depend on positions of the head in space; the latter are tonic and last as long as the head keeps a definite position.

To determine which reflexes were from the canals and which were from the otolith membrane, Wittmaack's method of centrifuging anesthetized guinea-pigs was utilized. By this method, it is possible to detach the otolithic membranes from the maculae and leave the ampullae and cristae of the canals intact. The check on this method employed by Magnus is complete in every detail. Physiologic investigation of successfully centrifuged guinea-pigs has shown that, after detaching the otolithic membrane, all reflexes responding to movement are still present and unchanged, whereas all reflexes resulting from position are absent. From this he concludes that the reflexes of Group 1 are elicited in the canals and those of the second group in the otolithic apparatus. So far as the otolithic apparatus is concerned, it can safely be concluded that all reflexes resulting from position are dependent on them, and that the maculae are, with the different positions of the head in space, and with different inclinations against the horizontal plane, in different states of excitation, which remain unchanged as long as the macula keeps its position. The otolithic apparatus is, therefore, the place of origin of tonic labyrinthine reflexes. The interesting feature is the

technic used and the completeness of this investigator's experiments. The intrinsic mechanism of the otolith organs are thoroughly investigated.

Magnus first determines the function of the otolith membrane on the hair cells of the maculae, and concludes that the otolith membrane increases or decreases the excitation of the hair cells according to their position in space by pulling at or pressing on the macula.

The origin of tonic labyrinthine reflexes on the extensor muscles of the limbs was determined to be in the utriculae. It was found that with the head of the animal tipped backward in the horizontal plane, the maculae sacculae have no characteristic position, but that both maculae utriculae lie in the horizontal plane. The extensor reflex on the limbs was greatest with the head backward, that is, the otolith membrane hanging or pulling on the macula, that it was weakest with the head forward, or when pressing on the macula.

The reflexes on the compensatory eye positions were studied. The rotary deviation has not been made out as yet, but the vertical eye deviation appears to depend on the sacculae. This is determined by extirpating one labyrinth. The well known eye deviation follows; that is, maximal if the head is in the lateral position with the intact labyrinth below; it is zero or minimal if the intact labyrinth lies above. This proves that the maculae in question cannot be situated in the same plane, therefore these reflexes must arise in the sacculae.

The symmetrical "righting" reflexes act so that of all possible symmetrical situations, the head is always held in such a position that the maculae utriculae lie horizontally in the minimal position. Thus, he concludes, the reflexes arise from the utriculae.

A most interesting feature is the description of an experiment in which one labyrinth is paralyzed by injection of cocaine into the middle ear; the other is extirpated. The paralysis of the labyrinth occurs by affecting the various structures in regular sequence; first, the sacculae, then the utriculae and last the cristae of the canals; the lateral first, one of the verticals last. Finally, the whole vestibular apparatus is out of function. The experiments are repeated, and as each structure becomes affected by the cocaine, the reflexes depending on it disappear.

Magnus states that the difference of function between the canals and otolithic maculae depend on the mechanical arrangement of the apparatus connected with the epithelium. In the canals, currents or pressure changes are evoked by accelerations, last only a short time and pass away. The otolith membranes, on the contrary, preserve their pulling or pressing action as long as the head keeps a definite position, causing tonic reflex actions. (The actual experiment on the animal which is placed in the various positions, and the observations as the

animal responds to the reflex stimulation has been omitted, the conclusions, with a word of explanation only, is given.)

Quix [9] gives a clear and concise anatomic, topographic and functional description of the vestibular organ. In his remarks concerning the otolith apparatus, he considers it essential to know its position in the human skull for the proper understanding of its mechanism.

The connection between the otolith and macula is not clear. They are separated by a space filled with substance in which fibers and hairs may be seen, and it is this connection which is of importance in order to acquire a knowledge of the function of this apparatus. Between the otolith and macula there is an elastic substance in which may be seen the conical hairs of the hair cells. Strong threads originating from the supporting cells of the macula and membranous wall penetrate the otoliths, thereby attaching the otolith to the macula. One gathers from his description that the utricular otoliths lie approximately in the same plane, saggitally, in a horizontal position, sloping slightly backward; thus, bending the head forward causes the otoliths to press on the macula, and, in this author's estimation, the maximum is reached with the head 30 degrees forward. Inclining the head backward decreases the pressure on the macula.

The otoliths of the sacculae lie in two planes obliquely; they look laterally and somewhat downward. As one inclines the head to the left with the right ear facing upward, the otolith would be pressing on the macula of the right ear and pulling on the macula of the left ear. It is the knowledge of when the otoliths are pulling or pressing on the maculae that gives us the key to the interpretation of the reflexes presenting from these structures.

Otolith stimulus produces three kinds of reaction: (1) the sensation of the position of the head in space; (2) a reflex in the autonomic nervous system such as symptoms of nausea, vomiting, etc.; (3) a reflex in the muscles of the eyes, neck, trunk and limbs.

The first and second reactions in patients are subjective, and form the chief portion of complaints in diseases or abnormal irritation of the otolith organs. Quix believes that the pressure of the utricular otoliths regulates the tonus relations between the flexors and extensors of the limbs, neck, and trunk, and between the superior and inferior recti of the eyes. If the pressure is raised, the tonus of the flexors is increased and that of the extensors decreased, while the rectus superior conducts itself as the flexors, the rectus inferior as the extensors. Decrease of pressure on the maculae produces the opposite effect. He considers the utricular organs synergists calling forth the same reflexes on both sides, and the plane of function is the median saggital one.

---

9. Quix, F. N.: J. Laryngol. & Otol. **40**:425 (July) 1925.

The pressure of the saccula otolith removes the tonus relation between abductors and adductors of the limbs, between the rotators of the neck and trunk, and between the musculi obliqui of the eyes. If the head is inclined toward the right shoulder, left ear uppermost, the pressure of the otolith on the left macula increases, while that of the right remains zero. In consequence, the tonus of the abductors of the limbs on the left side increases and that of the adductors on the same side decreases; while the tonus of the abductors of the right side decreases and that of the adductors of the right side increases, while the head is somewhat rotated to the right. The neck and trunk turn to the right, the eyes to the left with their upper pole through increase of tonus in the inferior oblique, and decrease in tonus of the superior oblique of the left eye; in the right eye, the relation is vice versa. The opposite reaction occurs with the head rotated to the left shoulder. Quix asserts that both saccula organs exert a constantly antagonistic influence on both sides of the body; they are, therefore, antagonists. The function plane is the frontal one.

Thus, the wonderful position of the otoliths in the skull in relation to the synergistic function of the utriculae and the antagonistic function of the sacculae, makes the otolith apparatus, like the semicircular canal system, an organ with mathematic, geometric function planes. The function of this apparatus Quix considers remarkable. It divides the positions, which the head can adopt in space, the saggital plane for utricular, the frontal for the saccular system. He considers that the main point of the otolith function does not lie in the muscle groups they bring into action, but in the plane in which they give attitudes to the head and to the body by changing the tonus. He says it is an organ for perception of the position of the head in space, and for stimulation required for significant positions of the eyes in the orbit. It gives further right to cause attitudes of the body which are appropriate during the position of the head, and which preserve equilibrium of the whole. This mechanical organ of sense acts perfectly in respect to the positions of the head which are assumed during the natural function of living, that is to say, when the head moves forward, backward, or to either side in a not too excessive degree.

Through changes in the position of the head in relation to the vertical, the pressure of the otoliths can also alter through the influence of centrifugal forces and through changes in the speed of rectilinear movements. The otolith reflexes, therefore, are often serviceable for orientation and for preservation of equilibrium, as, for instance, when jumping and during falling.

Mygind [10] touches on a few of the points about which there is the greatest dispute. Quix maintains that the reactions of the otolith organs

10. Mygind, S. H.: Acta Oto-Laryngol. **7**:161, 1925.

depend on the *pressure* of the membranes on the macula, while on the other hand, Magnus and deKleyn consider that they have proved that it is the *traction* only that counts. They both agree that a rotary eye and neck reaction arises from the sacculus. Quix lays the vertical reactions, both as far as eyes and neck are concerned, in the utriculus. Magnus and deKleyn refer them, so far as the eyes are concerned, to the foremost part of the sacculus (sacculus corner), and suppose that the neck reactions arise from the utriculus.

As neither of these investigators are in agreement, Mygind, from his own observations of phenomena seen in patients, and after careful anatomic and histologic consideration of the position and cellular arrangement of the neuro-epithelium of the maculae, believes that both traction and pressure are active in producing the stimulus. He considers the neuro-epithelium of the maculae to be divided in such a way that two parts, lateral and medial, lying in the same curve, yet opposite to each other are oppositely orientated, and produce reflexes opposite to each other. That is, traction on the lateral part has the reverse action to traction on the medial part, but has the same effect as pressure on the medial part. The same holds true for the anterior and posterior positions; thus, forward bending of head gives a reverse reaction to backward bending. He considers the lateral part of the neuro-epithelium to be dominant over the medial. Thus, by sideways bending, compensatory movements of the eyes to the opposite side of rotary nystagmus to the same side are due to correspondingly increasing and decreasing pressure (traction) on the different parts of the side curve (lateral or medial) of both utriculus and sacculus on both sides.

CLINICAL STUDIES OF OTOLITHIC REFLEXES

DeKleyn and Versteegh [11] studied the labyrinthine compensatory eye positions on a number of patients, and found that the rotary compensatory eye positions were the only tonic labyrinthine reflexes which enable them to gain a knowledge of the otoliths in normal persons. These reflexes are thought to arise from the maculae of the saccules. In the examination of the patients, great care was taken to exclude tonic neck reflexes on the eye movements by maintaining a fixed symmetrical position of the head in relation to the trunk. The reflexes due to movements which arose from the semicircular canals, after any change of the position of the head in space, they excluded by waiting a few minutes for them to subside. By an ingenious method described by deKleyn, they were able to measure in the terms of degrees the rotary displacement of the eyes with the head in different positions in space.

A group of normal patients, those with bilateral loss of function of the labyrinth, those in whom only one labyrinth was without function,

11. DeKleyn, A., and Versteegh, C.: J. Laryngol. & Otol. **39**:686, 1924.

and those with a partial loss of function of the labyrinth, were studied. They observed that in normal persons (*a*) the degree of rotation is small and does not play an important physiologic rôle; (*b*) there is a great difference between the rotary displacements in different persons as well as in the same person, with regard to both side positions; (*c*) the degree of rotation is not constant in the same person on different days. In the case of bilateral loss of function of the labyrinth a female, aged 17, who showed no response from rotation or caloric tests, accordingly gave no rotary eye displacement in either side position. This is as would be expected, if the theory holds true as to the place of origin for this reflex. Two cases in which one labyrinth was without function gave results analogous to the experiments on animals, that is, in the side position with the intact labyrinth underneath, the saccula macula lying horizontal, the otolith membrane pulling at the sensory epithelium, the rotary displacements were of a normal magnitude. No rotary movements were observed with the patient in the opposite side position, the otolith membrane pressing on the macula. The real value of the test appears in the patient with partial loss of function of the labyrinth.

Anatomically, the labyrinth is divided into two parts, (1) pars inferior which contains the cochlea and saccule, and (2) pars superior which contains the utricle and semicircular canals. Applied clinically, two types of partial lesion of the labyrinth may occur. If only the pars superior is disturbed, we will find normal function of cochlea and saccule with loss of function of semicircular canals and utricle, while if the pars inferior is disturbed, we should get normal function of the canals and utricles, but deafness and lack of compensatory eye positions (saccule).

These authors describe two cases with just such lesions, one with impairment of the pars inferior of the left labyrinth in which there was no function of the left saccule (no counter-rolling of eyes in the left side position). The other was a case affecting the pars superior on both sides. In this case, rotation and caloric test elicited no response from the canals. Hearing and compensatory rotary displacements of the eyes, however, were quite normal. This small group of cases is in no way conclusive, and the writers feel that further investigation is necessary, which they are continuing.

Kompanejetz [12] undertook to examine a number of deaf-mutes to test the theories of Magnus and deKleyn. In all, fifty-one were examined, forty-eight with regard to counter rolling of the eyes. They were divided into three groups as follows:

Group 1: Seventeen cases, in which all tests of experimentally evoked nystagmus had positive results.

12. Kompanejetz, S.: Acta Oto-Laryngol. **7**:323, 1925.

Group 2: Fifteen cases, in which all reactions on irritation of the vestibular apparatus was negative.

Group 3: The remaining cases in which the failing of the reactions of the vestibular apparatus were partial.

He was unable to confirm the observations of Magnus and deKleyn as to the origin of the reflex for counter rolling of the eyes. Some of his conclusions are that: (1) the innervation of the eyes has a separate place in the vestibular apparatus; (2) the influence of the deep neck sensibility of the eye musculature may be nil in man; (3) in cases of asymmetrical injuries of the otolith apparatus, a disturbance of associated eye movements in counter rolling of the eye may occur.

He considers this test impractical as compared with the other methods of inducing this phenomena. He feels that the test is too complicated, requiring special apparatus, demanding a highly intelligent patient, and cannot be applied to really sick, bedridden patients. He cites cases by Bárány, Voss, and Spinka, who also were unable to confirm the theories of Magnus and deKleyn regarding compensatory eye movements.

Quix [13] utilizes the past-pointing test in the clinical examination of the otolithic reflexes. He does not make use of the eye reflexes, the sensations of the head positions in space, or the reflexes on the autonomic nervous system. These he considers clinically unsuccessful. The test which he describes does not lend itself readily for abstract form, as it requires many diagrammatic sketches to visualize the author's text. Quix brings out the significance of the clinical examination of the otolith function in otology. In many patients suffering from acute and chronic middle ear inflammations, who complain of dizziness and nausea, with disturbance of equilibrium, the labyrinth is involved when no signs of disturbance of the canal system are found. In most of these cases, overstimulation of the otolith organ can be demonstrated by examination with the past-pointing test (Quix) with the head in position for maximum stimulation. It further enables us to test the individual parts making up the vestibular organ. The canals clinically are an entity. Symptoms hitherto attributed to the canal system can now be demonstrated to be due to disturbances of the otolithic apparatus. The complete analysis of the past-pointing test in the different function planes and directions shows the proper situation of the disease affecting the vestibular organ. Sea sickness, car and aviation sickness, can be explained as an overstimulation to the maculae. Quix considers the maculae sacculae the most sensitive development of the internal ear. Diseases affecting this structure give signs and symptoms early, and should warn us of impending trouble. Patients complaining of dizziness

13. Quix, F. N.: J. Laryngol. & Otol. **40**:493 (Aug.) 1925.

when on ladders, or when the head assumes various positions in the performance of their work, should be examined for disturbances of otolithic function. He considers that in Ménière's disease, otoliths play the chief rôle in the production of symptoms.

Mygind [14] gives an excellent account of his studies on the otolithic organs in patients, giving theories of his own in explanation of the phenomena evoked. The vestibular examination included the compensatory eye movements, rotation in the ordinary position of the head, or by forward bending of 30 degrees, and irrigation of both ears with both cold and warm water. Particular attention was attached to the ocular phenomena, the value of the pointing and falling tests being at present too dubious to be practically considered in his estimation. He considered as otolithic cases those which presented phenomena when the head was in a certain position in relation to the line of gravity, regardless of the movements by which the position was obtained, and that they continued as long as the patient's head retained the same position.

From the numerous examinations in the various positions, he found that nystagmus as a neck reflex in human beings does not occur in such a way that they give rise to mistakes, and that ampullar reflexes are not difficult to distinguish from otolithic reflexes. As a rule, it was sufficient to examine the patient only in a side position, the head and neck being fixed together as much as possible during the movement. In these investigations, it was found that ampullar nystagmus could be distinguished from otolithic nystagmus by these characteristics: (1) Ampullar nystagmus occurs especially in cases of rapid change of position; (2) they appear momentarily; (3) they rapidly diminish in strength in from a few to about twenty seconds; (4) the eye reactions take place in the plane of movement; (5) by eventual reproduction of the reflex by reproduction of the movements but not of the position of the head.

The otolithic nystagmus, on the contrary, is characterized by: (1) appearing without reference to the celerity of the movement; (2) often appearing after some seconds of latency; (3) the reaction lasting as long as the position is maintained with some nystagmus; (4) the reaction not necessarily taking place in the plane of the movement; (5) the possibility of reproducing the reflex by reproducing the position of the head in relation to the line of gravity without reproducing the movement.

In the examination of these otolithic cases, Mygind found interesting variations in both form and intensity of the nystagmus. He also found that nystagmus in the various positions of the head in human beings corresponded exactly, both as regards its form and direction, to what is seen in animals in the same positions of the head, only the

14. Mygind, S. H.: Acta Oto-Laryngol. **7**:161, 1925.

slow phase is seen in animals. He cannot see why there is any reason, because the reaction in human beings expresses itself in nystagmus, while in animals it expresses itself as a slow phase, to doubt that the reactions are identical, and therefore also in man apply to an otolithic reflex. He considers the compensatory eye movements and the rotary nystagmus in the side position as identical. He believes that all the reflexes seen in animals are really in action in human beings, but so weak and checked that they are not demonstrable in exactly the same way; in normal people we do not elicit semicircular canal reactions unless they are hyperphysiologically raised, as in testing by rotation.

HYPOTHESES REGARDING FISTULA SYMPTOMS

Mygind [15] asserts that the labyrinth fistula symptom is an otolith reaction caused by increase or decrease of the endolabyrinthine pressure, in which the direction and form of the eye movement depend only on the state of irritability of the neuro-epithelium of the maculae. This belief, in his estimation, gives a simple and exhaustive explanation of all the different forms and varieties of phenomena met with experimentally and clinically. The explanation of the labyrinth fistula symptoms given by Nylen, Herzog, and others, Mygind believes to be inadequate as they do not explain the reversed fistula symptom. His own supposition, as far as he knows, is not at variance with established facts, and explains reasonably the fistula symptom, whether regular or reversed.

Mygind says the direction and form of the eye movements have nothing to do with the seat of the fistula. When the symptom is regular, it means that the maculae are in a condition of well preserved irritability, that an increase of the endolabyrinthine pressure acts physiologically, producing a nystagmus to the opposite side. If, however, the function of the maculae is, to a certain degree, injured from an existing or past edema of the labyrinth, an increase of the pressure, on the contrary, will no longer act as before, but only reduce the function still more, while a decrease of the pressure may act as a relief, the result in both cases being a reversed fistula symptom. Thus we understand why a slight pressure may produce a normal symptom, but a greater pressure a reversed one. We can understand how the direction of the eye movements in the same kind of an experiment can change from one movement to the other.

From experiments carried out so far, Nylen [16] thinks that the otolith membrane and perhaps also the otolith organ, are not necessary conditions for the creation of a fistula symptom by pressure, at least not

15. Mygind, S. H.: J. Laryngol. & Otol. **39**:501, 1924.
16. Nylen C. O.: Ztschr. f. Hals-, Nasen-, u. Ohrenh. **9**:398 (Dec. 6) 1924.

in the guinea-pig. They do point to the fact, however, that the fistula and pseudofistula symptoms principally and essentially, are set in action by the semicircular apparatus.

These statements are made in reply to Mygind's article mentioned previously. Nylen bases his remarks from experimental studies on a guinea-pig, in which the otolith membrane of the utriculus was removed. As to the reversed fistula symptoms, Nylen remarks: "direct pressure on an erosion of the lateral semicircular canal can be caused as well by an intralabyrinthian change which prevents the normal extension of pressure to the horizontal ampulla, as it can be caused by an injury of the nerve epithelium of the macula with a diminished power of reaction by pressure."

Ruttin [17] disputes the theory of Mygind as to how the labyrinthian fistula symptoms arise. He claims that Mygind is not justified in assuming that the fistula symptom is an otolith reaction; aside from that he cannot justify Mygind ignoring the existence of the ampullae. The mechanism of the pseudofistula symptoms is unexplainable. Ruttin does not agree that in syphilis the fistula symptom is practically always reversed.

STUDIES ON LABYRINTHIAN PHENOMENA

In a preliminary report on the nature of the impulse which affects the crista ampullaris of semicircular canals, Novak [18] surveys briefly the views and reasons for the same, up to the present time. As these views are not wholly acceptable either becauses of lack of conformity of experimental findings, or are not based on the facts of physics, he proposes the possibility of the impulse to be electrical. This is a departure from the usual postulations. To prove his views, he carried out two series of experiments.

In Series 1 of his experiments, the electrical current was produced by dissociating the sodium chlorid solution by heating, into its elemental ions. A difference of (electrical) potential was thereby created which resulted in an electrical current.

In Series 2 by centrifuging the solution, there is again a dissociation of the ions, the heavier chlorin ions at one end of the tube, the lighter ions at the other. By the same laws of physics, the resulting electrical current is produced just as in Series 1.

His conclusions are that in the human labyrinth, the phenomena is of the same kind, namely, heat reaching the endolymph, dissociates its ions creating an electric current which is an adequate stimulus of the crista ampullaris.

---

17. Ruttin, E.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **9**:541 (Jan.) 1925.

18. Novak, F. J.: The Nature of the Impulse Which Affects the Crista Ampullaris of the Semicircular Canals, Arch. Otolaryngol. **1**:213 (Feb.) 1925.

In the opinion of Schmaltz,[19] the long duration of after-nystagmus in connection with rotation test constitutes a serious objection to the Mach-Breuer theory of excitation of the semicircular canal, since (as he points out) it may readily be perceived that the period of oscillation of the cupola amounts to only a few hundredths of a second, and, further, that in employment of caloric methods of slight irritation, displacements of endolymph may amount only from a few hundredths to tenths of a millimeter, and in many instances nystagmus must persist beyond that period. Schmaltz therefore assumes that an osmotic and not a mechanical action is involved in stimulation of vestibular organs of sense. He believes that endolymph exhibits a degree of concentration different from that of other body fluids, the blood in particular. It was observed that an extremely gradual migration of ions occurred through the gelatinous matter of the cupola, and that a film of fluid of somewhat different concentration formed around the cupola. It is explained that the symmetry of this film and with it the equilibrium of diffusion may be disturbed by mechanical and thermic action, and that this leads to excitation of fibers of the vestibular nerve, which may, according to site of alteration in concentration, affect one or the other side. Thus, excitation may cease entirely when displacement of fluid has become so marked that both sides of the cupola are in contact with approximately free endolymph. Analogous considerations are said to apply to excitation of the otolithic organs.

Goldstein and Riese [20] observed that on cooling with a jet of ethyl chloride, the phenomena are the same as those observed in thermal stimulation of the labyrinth. The labyrinthine reflexes, therefore, are not unique, but simply an expression of a general reflex phenomenon, which can be set in action in other ways than by stimulation of the labyrinth.

In another paper, a detailed description is given of a patient with a cerebellar lesion, in whom thermal stimulation of the neck produced variations of the normal reflex.

Goldstein and Riese [21] demonstrated that in the past-pointing test instituted following calorization, an individual with fixed head and trunk not only touches a point of the original median line, when the finger has previously been conducted toward the latter (Wodak's test), but may find it possible to do so even without this aid. When the individual past-pointed in the direction of the calorized side, the arm was moved in a straight line, but when he pointed correctly without tactile aid, the arm was moved toward the median line in a concave arc in the

19. Schmaltz, G.: Arch. f. d. ges. physiol. **207**:125-128, 1925.

20. Goldstein, K., and Riese, W.: Klin. Wchnschr. **4**:1201-1204 (June 18) 1925; ibid, p. 1250 (June 25) 1925.

21. Goldstein, K., and Riese, W.: Monatschr. f. Ohrenh. **58**:931-940, 1924.

direction of the uncalorized side. It is assumed that in the second instance the individual reveals the possession of sensibility, and the arm is drawn in the direction of the calorized side. Thus, movement is altered in accordance with optical perception of the original median lines, but, in the opinion of the authors, no alteration in conception of direction occurs, as Wodak is said to have believed. On the contrary, correct perception of median lines which are displayed in the direction of the calorized side is declared to exist, since a change of innervation (Bárány) in the sense of a turning of the body toward the calorized side is produced by action of heat. Execution of the movement is prevented only by restraint of the person, and occurs as soon as the latter is released. However, it is asserted that the experience of turning is present in every instance and conception of direction is retained. The authors explain that when a tactile perception of an objective is afforded, no actual pointing (but merely repetition of tactile experiences) is involved in the test.

Patients with cerebellar disease who exhibit disturbances of coordination with past-pointing, are said to past point spontaneously as well as following tactile or optical perception, for the reason that consciousness of a disturbance of coordination is lacking in them. Thus, as they point correctly with the hand on the sound side, these patients are declared to present no disturbance of conception of direction. Identical phenomena are said to be observed in application of the pointing test to healthy persons following rotation, but, on the one hand, kinesthetic correction is more readily effected, while on the other hand the marked disorientation induced by rotation impairs compensation, even that obtained by means of optical perception. Therefore, in the judgment of the authors, past-pointing, strictly speaking, is not involved in the great majority of instances, since the person who is being tested points wrongly in an objective sense according to his experience and past-pointing frequently constitutes a spontaneous improvement. Past-pointing is described as the result of artificial isolation of the arm; the less movable the parts of the latter, the more pronounced the past-pointing. The authors regard it as probable that an influence on innervation of the entire body, which may manifest itself in varying degree in accordance with freedom of movement of portions of the body, is here involved.

HYPOTHESES ON CALORIC NYSTAGMUS

After due consideration and acknowledgment of the theories of Bárány, Bartels, Kobrak, Borries, deKleyn, and Robertlund, so far as they explain in part the caloric nystagmus, Mygind [22] proposes that

22. Mygind, S. H.: J. Laryngol. & Otol. **40**:444 (July 25) 1925.

the caloric nystagmus consists of two reactions. One gives a reversion by forward bending, the other does not. The one that gives reversion is a semicircular canal reaction, the other an otolith reaction. Bárány's theory, in his estimation, holds good for the reactions from the semicircular canals. The otolith reaction is due, he believes, to a change of tonus of the otolith organs, probably produced by a change of temperature so that it increases by warming and decreases by cooling. The action on the maculae is probably due to a direct thermal irritation or paralysis.

When the head is in the ordinary upright position or when inclined to the side, the otoliths and the semicircular canals cooperate. Under normal conditions, by forward bending the semicircular canal reaction is the strongest and apparently the decisive one. The otolith reaction asserts itself only under pathologic conditions when the function of the semicircular canals is extinguished or diminished in relation to that of the otolith organs; then there is no reversion by forward bending.

The state of irritability of the neuro-epithelium in the cistae and maculae determines the reaction obtained by caloric stimulation and explains the great variation seen in pathologic cases.

Meurman [23] remarks on two theories of the origin of caloric nystagmus: (1) Bárány, who traces it to the specific weight of the endolymph; (2) Kobrak who, carrying out experiments by minimal irritation, attributes the caloric nystagmus to changes in volume of the blood vessels.

Meurman proceeded to experiment on human cadavers. A thermo element was passed into the labyrinth by way of an opening in the lateral part of the anterior vertical semicircular canal and introduced as far as the ampulla of the horizontal canal. The labyrinth was filled with almond oil or glycerine, and a mirror galvanometer was employed. Minimal caloric stimulation was used. Experiments also were carried out on living subjects, when, using strong convex glasses, the effect of rotation on the caloric nystagmus was noted. The writer concludes in favor of Bárány's theory.

Borries [24] recapitulates the data on which his theory is based, referring to the experiments which have been made on pigeons after ablation of the semicircular canals. He can neither reconcile the facts with mere thermal alteration in the specific weight of the endolymph nor accept other more recent hypotheses, which he reviews critically. Borries considers that the semicircular canals are not concerned in

23. Meurman, Y.: Acta Oto-Laryngol. **7**:555, 1924.
24. Borries, G. T.: Arch. f. Ohrenh. **113**:2-3 (June) 1925.

the production of caloric nystagmus, which he regards as a general labyrinthine reaction, liberated from the cristae and especially from the maculae, the influence of the position of the head arising from the otolith apparatus. He postulates a specific sensibility for thermal stimuli, analogous to that for galvanic or pressure stimuli, affecting the homolateral or contralateral nystagmus tone of the labyrinth, but he does not entirely exclude from his calculations vasomotor effects and alterations in endolabyrinthine pressure (William Oliver Lodge).

CALORIC STUDIES

MacFarlan [25] gives us a clear conception of the quantitative reactions first described by Brunings and elaborated on by Kobrak. The use of minimal stimuli to the labyrinth with measured amount of fluid is strongly advocated abroad. It is believed that much can be learned by this method. According to Brunings, the best position in the use of this caloric reaction is with the head backward 60 degrees, slightly inclined toward the shoulder of the ear douched, at 27 C. (82 F.). The fluid is permitted to flow slowly. He noted that twitchings of the eye appears after 60 to 70 cc. of water has been used. Kobrak modified this method somewhat, feeling that he did not actually know when the reaction began, that is to say, the actual twitchings may appear some time after the stimuli affected the neuro-epithelium. Kobrak begins douching with 5 cc. of water at 70 F., then waits to see if any nystagmus appears. If none appears, he waits a minute or two, then douches again with 10 cc.; if no reaction occurs he waits for five minutes and tries 20 cc. If a reaction occurs, he waits again until all signs of irritation subside and begins to reduce the amount of water used, several cubic centimeters at a time until the minimal amount of water that produces reaction is determined. By this method, Kobrak ascertains "1. The minimal amount of water that is necessary to start a reaction. 2. It determines the time from the beginning of the douching until the beginning of the nystagmus, which nystagmus may not be physiologically strong enough to determine the duration of the action which may perhaps be accepted as the estimated time of reaction."

In his application of this test, McFarlan used 10 cc. of water at 50 F., or 15 cc. at 60 F., as it made the threshold sharper and the reaction more distinct after this quantity of water was used. McFarlan further reports on a number of patients with labyrinthine disturbances to illustrate vestibular accommodation, and impresses us with the importance of bearing this in mind in examination of such patients. In his article the author gives some valuable clinical points well worth restating.

---

25. MacFarlan, D.: Ann. Otol., Rhinol. & Laryngol. **34**:160 (March) 1925.

1. That Brunings' position is advisable but not essential.

2. Full rest periods between consecutive douchings must be given after subminimal stimulation is accumulative, and may be equivalent to a minimal stimulus.

3. Have the patient look casually at a distant object so as not to diminish or check the nystagmus.

4. Using minimal stimulation in normal labyrinths rarely produces any subjective symptoms.

5. The extent of the excursion of the nystagmus seems to bear no relation to the amount of minimal stimulus required.

6. In diseased labyrinths, whether hyposensitive or hypersensitive, the degree of accommodation that is taking place is of the utmost importance in judging the findings. If the labyrinthine pathology is on one side only, the healthy labyrinth usually partakes in the accommodations, and in time may become irresponsive to caloric and to turning tests.

PHYSIOLOGIC CONSIDERATIONS OF NEURO-OTOLOGIC PROBLEMS

In an exhaustive article by Ingham and Jones [26] in which neuro-otologic problems from a clinical standpoint are considered, the authors attempt to determine (1) what may be considered theoretic; (2) what may be regarded as highly probable, and (3) what may be regarded as reasonably proved, including the phenomena on which we can rely in clinical diagnostic work. In their discussion of experimental and clinical research, although both have advantages and disadvantages, they feel that each method of research in many ways supplements the other, and that progress will be determined largely by the cooperation of the investigators using the different methods of approach. The article is replete with both physical and physiologic data; the authors weigh their evidence exhaustively, and conclude as to that which is theoretic, probable, or reasonably proved, as follows, quoted from the authors' summary:

Theoretic:

1. The available evidence suggests that there is a cortical area for the reception of impulses from the vestibular end-organ.

It is probable:

1. That a cerebral cortical center for hearing is located in the temporal lobe of each hemisphere.

2. That the otoliths and the cristae of the semicircular canals cooperate in function.

3. That vestibular fibers are not distributed to the peripheral oculomotor neurons, but to the neurons of an ocular coordinating mechanism.

---

26. Ingham, S. D., and Jones, I. H.: Ann. Otol., Rhinol. & Laryngol. **34**: 297 (March) 1925.

4. That the quick component of vestibular nystagmus can be produced by a lower mechanism without impulses from the cerebrum.

5. That the impulses from the internal ear, producing a sense of movement, pass through the cerebellum en route to the cerebrum.

Reasonably proved; to be relied on in clinical work:

1. Capillarity does not prevent endolymph movement within the semicircular canals.

2. There is a coordinating mechanism for ocular movements within the brain stem.

3. Spontaneous vertical nystagmus in patients who have other symptoms of intracranial lesion, indicates that the lesion is located within or adjacent to the brain stem.

4. Perverted nystagmus after ear stimulation is indicative of involvement of the brain stem, by infiltration or adjacent pressure.

5. Tumors of the cerebellopontile angle frequently show a typical neuro-otologic phenomenon complex.

6. There is an appreciable separation of the neuraxial pathways of the fibers in relation to the vertical canals.

News and Comment

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY

The American Laryngological, Rhinological and Otological Society will hold its annual meeting at the Mount Royal Hotel, Montreal, Canada, May 31 to June 2, inclusive. President, Dr. John M. Ingersoll, Cleveland, Ohio; Secretary, Dr. Robert L. Loughran, 145 West 58th St., New York City.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY

The Pacific Coast Oto-Ophthalmological Society holds its annual meeting in San Francisco, April 26, 27 and 28, 1926. The American Board of Ophthalmic Examinations and the American Board of Otolaryngology plan to hold examinations in San Francisco in conjunction with this meeting. Those desiring to take these examinations should write immediately to Dr. W. H. Wilder, 122 South Michigan Avenue, Chicago, secretary of the Ophthalmic Board, or to Dr. H. W. Loeb, 1402 South Grand Boulevard, St. Louis, secretary of the Board of Otolaryngology.

LOCAL SOCIETY MEETINGS

CHICAGO: Chicago Laryngological and Otological Society meets on the first Monday of the month from October to May at the Crystal Room, Great Northern Hotel. Chairman, Dr. E. H. Norcross; Secretary, Dr. A. A. Hayden, 25 East Washington Street.

CLEVELAND: Ophthalmological and Otolaryngological Section of Cleveland Academy of Medicine meets on the fourth Friday of each month at the Winton Hotel. Chairman, Dr. E. W. Garrett; Secretary, Dr. M. Paul Moto, Rose Building.

DENVER: The Colorado Oto-Laryngological Society meets on the first Saturday of the month from October to May, at the Assembly Room, Metropolitan Building. President, Dr. William C. Bane; Secretary, Dr. C. Howard Darrow, Metropolitan Building, Denver.

KANSAS CITY, MO: Kansas City Eye, Ear and Nose Society meets on the evening of the third Thursday of each month from September to May, at the Baltimore Hotel. The afternoons of the third Thursday of November, January and March are given over to clinical work. President, Dr. James May; secretary, Dr. A. E. Eubank.

MILWAUKEE: Milwaukee Oto-Ophthalmic Society meets on the third Tuesday of the month, at the University Club, at 6:30 p. m. President, Dr. John E. Guy; Sec.-Treas., Dr. John J. Brooks, Majestic Building.

NEW YORK: Otological Section of New York Academy of Medicine meets on the second Friday of each month from November to May, at 17 West 43d Street. Dr. James Morisset Smith, Chairman; Dr. J. L. Maybaum, 12 East 86th Street, Secretary. Laryngological and Rhinological Section of New York Academy of Medicine meets on the fourth Friday of the month from November to May, at 17 West 43d Street. Otolaryngological Section of the Kings County Medical Society meets on the second Wednesday of January, March and May, at 1313 Bedford Avenue, Brooklyn. Dr. Harry Meyersberg, Chairman; Dr. Charles Breitman, 210 Brooklyn Avenue, Brooklyn, Secretary.

PHILADELPHIA: Section on Otology and Laryngology of the College of Physicians of Philadelphia meets on the third Wednesday of each month from October to June, at 8:30 p. m., at the College of Physicians. Chairman, Dr. Fielding O. Lewis; Secretary, Dr. James A. Babbitt, 2117 Chestnut Street.

Abstracts from Current Literature

Ear

TWO UNUSUAL CASES OF CHOLESTEATOMA OF THE MIDDLE EAR. GINO MERELLI, Arch. ital. d. otol., rinol e laringol. **36**:491-500, 1925.

Merelli reports in detail two cases. In one, he was surprised to discover an unsuspected cholesteatoma at operation. There had been no chronic purulent otorrhea immediately preceding, and the morbid process appeared in its symptom complex to point to an acute type of disease, with no indications of anything other than an ordinary acute mastoiditis. In the second case, a girl, aged 8, presented a bilateral cholesteatoma, the infection having spread from one ear to the other. The infection of the left ear was not evidenced by otorrhea, the tympanic membrane being intact, although the infection had undergone slow development.

WOLCOTT, Chicago.

LABYRINTH INVOLVEMENT IN TRAUMA OF THE HEAD. HANS BRUNNER, Monatschr. f. Ohrenh. **6**:697, 763, 922, 1925.

A study has been made of ninety-eight clinical cases, with microscopic examination of nine temporal bones from patients who either died after trauma to the head or who at some time suffered a trauma. In addition, twelve guinea-pigs have been subjected to experimental trauma under narcosis, and their temporal bone changes recorded together with microscopic findings in the brain in four instances.

Stenger first attempted to analyze and to classify the pathologic changes of the inner ear after head trauma. Ulrich and Manasse inclined toward a grouping according to remaining ear functions. Mauthner suggested the possibility, and later Jakob demonstrated the actuality of central involvement (nucleus octavus). Brunner divides head trauma into: (1) commotio cerebri; (2) commotio cerebri et auri internae; (3) fractura capsuli labyrinthi.

The first group includes cases in which clinically the ear findings point to a central involvement of the eighth nerve; the second group possesses, in addition, inner ear symptoms due to involvement of the membranous labyrinth. Transverse fracture through the petrous bone with its syndrome is placed in the third group. To illustrate the first group, a case may be cited.

CASE 3.—On March 3, 1922, a boy, aged 14, fell on his head from a parallel bar. When seen, he was unconscious and vomiting. The pupils reacted sluggishly, the fundi were normal; neurologic findings otherwise were normal.

On March 8, each finding showed that the drum and cochlea were normal. First degree horizontal nystagmus to the left, and a horizontal rotatory nystagmus to the right were present. The Romberg test was doubtful. There was no spontaneous past-pointing; the galvanic reaction was normal. On Feb. 9, 1923, there were no subjective symptoms. The drum and cochlear findings were normal. Spontaneous nystagmus persisted as before and could be intensified by vigorously shaking the head. Caloric hyperirritability was present.

Sixty cases of commotio cerebri have been collected; of these twenty-six showed eighth nucleus involvement. It is interesting to note that nine patients had a severe hemorrhage from the ear following the trauma, their hearing.

however, remained normal. The bone conduction in all cases of this group was of normal duration coinciding with the reports of Bezold, Herzog and Fremel, but in conflict with those of Wanner and Gudden. Whether a patient actually has a labyrinthine vertigo, though spontaneous nystagmus be absent, can be determined by the presence of caloric hyperirritability. To illustrate the second group, a case is quoted.

CASE 4.—On Feb. 19, 1923, Mrs. M. K. was seen. She was unconscious, having fallen from a wagon. The pupils reacted, blood was escaping from the right ear. On the following day, the patient regained consciousness and complained of headache and vertigo. The eyegrounds and neurologic examination were negative. There was no hematotympanum in either ear. The whispered voice could be heard in the right ear at half a meter distant; in the left, at a distance of 12 meters. The Schwabach reaction was normal. The Rinne test was negative; c4 was normal on the left, but was not perceived on the right. Second degree horizontal-rotatory nystagmus to the left was present. Roentgen-ray examination disclosed two longitudinal fissures in the petrous bone. On February 27, spinal fluid removed under pressure was opalescent, the sediment disclosed great predominance of lymphocytes. On March 10, first degree horizontal-rotatory nystagmus to the left was present. There was no spontaneous past-pointing. The whispered voice was heard in the right ear at a distance of 1 meter; in the left, at 12 meters. In the left ear c4 was normal; in the right, it was markedly shortened. Vigorously shaking the head elicited a horizontal rotatory nystagmus to both sides. In January, 1925, there were no subjective symptoms. The Romberg sign backward was noted. The whispered voice was heard in the right ear at a distance of 1 meter; in the left ear, at a distance of 12 meters. Caloric reaction in the left ear showed hyperirritability; in the right there was no reaction. After-turning nystagmus was normal. First degree spontaneous horizontal-rotatory nystagmus to the right was present. A watch held on the right mastoid was not heard.

This case illustrates a "lymphokinetic" involvement (Neumann). The hearing is diminished, spontaneous labyrinthine symptoms are present and a negative caloric reaction with a normal turning reaction. The symptoms and findings have persisted for two years. (The deafness on the right side is partially due to actual involvement of Corti's organ, as evidenced by the diminution in perception of the higher tones and the watch.)

The third group of the classification comprises the fractures of the petrous bone passing through the labyrinthine capsule. Marked destruction occurs especially in the vestibulum, and the trauma is usually lethal to the patient. Patients who live do not regain any of the auditory nerve functions, and many succumb sooner or later to a secondary meningitis.

Summarizing, Brunner states:

1. Experimental production of commotio cerebri in guinea-pigs has disclosed degenerative changes in the nucleus of the cochlear and particularly of the vestibular nerve. These pathologic changes persist, and can still be observed when the examination is made a long time after the induced trauma. The changes in the brain are attributed partly to the direct action of the trauma on the brain tissue and partly to the circulatory disturbances.

2. About 43 per cent of the cases of commotio cerebri show ear symptoms, consisting of (*a*) true labyrinthine vertigo; (*b*) spontaneous nystagmus; (*c*) caloric hyperirritability; (*d*) tinnitus; (*e*) normal cochlear findings.

3. The prognosis of commotio cerebri is disturbed by the occurrence of attacks of dizziness for many years.

4. Commotio cerebri can be proved some years after the trauma by the presence of caloric hyperirritability, or by the experimental production of a nystagmus on vigorously shaking the head.

5. The term — commotio auris internae (Alexander) — denotes all the symptoms and changes of the inner ear due to head trauma without fracture of the labyrinthine capsule. The pathology consists of (*a*) hyperemia and perivascular exudate; (*b*) hemorrhage and exudation into the endolymphatic and perilymphatic spaces; (*c*) free blood, blood pigment and connective tissue in the aquaeductus cochleae; (*d*) ecchymosis at the insertions of the membrane of the round window. The perception epithelium is apparently unaffected.

6. The subjective disturbances from a trauma are due to concussion of the lymphatic fluids and disturbances of the circulation. The symptoms due to the concussion disappear shortly, but the circulatory disturbances (the "otitis interna vasomotoria"), persist as the responsible feature for the commotio auris internae.

7. The "otitis interna vasomotoria" affects either the perilymph alone, or the perilymph and endolymph. In the former instance a deafness of the sound conducting apparatus occurs, while in the latter, besides deafness there are spontaneous labyrinthine symptoms, abnormal caloric reactions with perhaps normal after-turning nystagmus.

8. Marked vertigo and nystagmus sometimes occur suddenly after a head trauma if the patient assumes a certain position.

9. If, after trauma, sound conducting and sound perceiving deafness (middle and inner ear) result, much improvement in the hearing cannot be expected. If only middle ear deafness results, the prognosis for improvement of the hearing is good, especially in young and healthy patients.

10. The inner ear changes found in a patient dying from head trauma cannot be taken as the pathologic picture of commotio auris internae in the patient who outlives the trauma.

11. Transverse fracture through the petrous bone passes through the labyrinthine capsule and is usually fatal. Should the patient live, total permanent deafness results with no reaction on caloric stimulation; however, vestiges of labyrinthine function may in some cases be elicited, and then the differential diagnosis between fracture and severe commotio cannot definitely be settled.

GLOWACKI, Detroit.

NEURITIS AND LABYRINTHIAN CARCINOMATOSIS. (SECOND COMMUNICATION CONCERNING THE PATHOLOGY OF THE ACOUSTIC NERVE IN MALIGNANT TUMORS.) T. D. DÉMÉTRIADES, Ztschr. f. Hals-, Nasen-u. Ohrenh. **11**:502 (Sept. 8) 1925.

The otologic examination of patients suffering from malignant tumors of various localizations showed that decrease in function of the hearing organ occurs especially in carcinomas and in sarcomas. The symptoms consist of progressive hardness of hearing, which begins with a shortening of the time of the perception for low tones and labyrinthian hypo-irritability in the beginning, concerning caloric minimal irritation. Both are mostly of a reversible nature.

They may recede to the greatest extent after surgical removal of the tumor, or therapeutic efforts by application of radium or by roentgenization. Démétriades tried to study the anatomic pathologic cause of these ear symptoms in malignant tumors, and the mechanism of the origin of the central and peripheral degenerations by virtue of histologic specimens. Many authors have studied primary, secondary and metastatic malignant tumors of the hearing organ, but their findings can only be utilized for special considerations because in some of the patients the labyrinth had not been examined, or because the histologic examination was missing. With the others, especially in metastatic tumors of the inner meatus, the nerve and the inner ear had been infiltrated by the tumor. Therefore, the question of the purely distant effect, namely, the toxic influence on the hearing organ could be considered only to a limited extent. The author studied eight cases very thoroughly, and came to the following conclusions:

1. In malignant tumors which are far from the ear, or near the same, and in those which grow secondarily into the ear, the toxic effect of the tumor is the cause of the decrease in function. This is also the case in primary and in metastatic tumors of the hearing organ, so long as the labyrinth is not infiltrated by the tumor. Yet, in cases with direct destruction by infiltration and pressure, the toxic component seems to be of importance.

2. The process in the ear is the consequence of a primary toxic lesion of the whole vessel system of the ear, and of the central portion of the acoustic nerve. This is followed by a toxic lesion of the nerve elements.

3. At the periphery, which seems to be the essential place of the clinical symptoms, the process begins, aside from the neuritis, with a labyrinthopathia exsudativa carcinomatosa (labyrinthitis). The middle ear plays a minor part with the exception of the tumors in the epipharynx.

4. The degenerative atrophy of the central and peripheral portion of the acoustic nerve must be considered partly as the end-result of these processes.

5. Two stages must be differentiated. The first stage is of a reversible nature. The second stage can scarcely be influenced by removal of the tumor. This stage corresponds with the time when a decrease of the turning, and sometimes also of the galvanic reaction, is present, besides a pronounced decrease of the time of perception of tunes (also of the higher tunes) and of the acuity of hearing.

6. A homolaterality exists, as all symptoms and pathologic histologic findings are more pronounced on the ear next to the tumor, compared with the other ear, if no other disease was preceding.

AMBERG, Detroit.

"FROM THE PROCEEDINGS OF THE GERMAN OTOLARYNGOLOGICAL SOCIETY 1925"

TOPOGRAPHIC-ANATOMIC STUDIES OF THE BASAL CISTERNAE. L. Boss, Ztschr. f. Hals-, Nasen-u. Ohrenh. **12**:143 (Nov.) 1925.

The author uses a special technic for removing the upper part of the skull and overlying parts of the brain. He injects a solution of agar with methylen blue through the suboccipital route into the cisterna magna, thus filling the cisternae with a plastic mass, showing their extent and relations. Of especial interest is the outward extent of the cisterna pontis laterali along the petrosa to a line drawn from the porus acusticus interna to the apertura interna canaliculus cochleae, including both these openings within the cisterna, also the trunk of the facialis acousticus. Other nerves included are the vagus, glossopharyngeus, trigeminus and abducens.

CISTERNA DRAINAGE IN THE THERAPY OF OTOGENIC MENINGITIS. M. GOERKE, Ztschr. f. Hals-, Nasen-u. Ohrenh. **12**:144 (Nov.) 1925.

The author advises drainage of the cisterna pontis lateralis. He proceeds by uncovering widely the dura of the posterior and middle fossae (following the usual radical mastoid operation) which are joined by removing the angle of the pyramid. This gives better access to the field. He also uncovers the posterior fossa behind the sinus and downward as far as the lower knee thereof for the same purpose. He then removes the petrosa as far as the labyrinth capsule (Bogengang massif; posterior canal prominence). The dura is then elevated with a septum elevator along the angle of the pyramid as far as the internal auditory meatus, and downward to the bulbus jugularis. A 1 cm. incision is made in the dura between the meatus and the apertura interna, which lies 8 mm. deeper. This is followed by a profuse gush of liquor, and a gauze drain is quickly inserted. If a labyrinth operation is indicated, the cisterna is located with greater certainty by following the usual labyrinth operation through to the meatus.

He states that this procedure is rational as it follows the route of the infection, gives free and persistent drainage, without danger of brain prolapse, and an opportunity to discover the route of the infection, and associated pathology, such as sinus phlebitis or cerebellar abscess, if present.

He has operated on five patients, with two recoveries, and alleviation of the symptoms of the others (cultures of the spinal fluid are not reported). He credits Bárány with the first description of the cisterna lateralis complex, and Holmgren and Uffenorde with priority in cisterna drainage operation from which his is adapted.

THE DIAGNOSTIC SIGNIFICANCE OF CISTERNA PUNCTURE, ALSO THE COMBINED CISTERNA AND LUMBAR PUNCTURE. ZANGE and KINDLER, Ztschr. f. Hals-, Nasen-u. Ohrenh. **12**:150 (Nov.) 1925.

This procedure is advocated for the determination and location of subarachnoid block, in which case pressure on the jugularis causes no rise in the pressure of spinal fluid either at the cisterna or lumbar regions. If it fails to rise only in the lumbar region, the block is spinal. Air pressure fluctuating the fluid between the two levels, or staining solution flowing through also indicate absence of spinal block. The cisterna puncture is considered preferable for diagnostic purposes of intracranial conditions, as it is nearer the pathology, and shows changes earlier.

Cerebral block occurs from exudates or tumor pressure closing the foramen Magendie or Luschká's foramina, interfering with ventriculocisterna communication. Increased intracranial pressure is exerted in all directions, and only when fluid is removed from the cisterna magna and spinal sack faster than it can flow in again from the ventricles, are cranial contents forced into the foramen magnum. This may not always be an immediate result, but may occur gradually as the result of progressive block of the ventriculosubarachnoid communications brought about by lesser displacements of cranial contents resulting from withdrawal of small amounts of liquor. Authors advise in case of suspicion of block, for instance finding a solider mass instead of liquor or little fluid after the needle is felt to go through the atlanto-occipital ligament, that physiologic sodium chlorid solution be used to replace the lost fluid. Authors suggest also the possibility of removing through a larger needle some

cranial contents for biopsy. Authors also report one case of cisterna block, in which the pulse pressure fluctuations usually seen in spinal puncture, were absent, and several cases in which the cytologic and chemical changes in the spinal fluid were misleading because of lack of communication with the source of the trouble.

Finally one of them (Kindler) reports the recent discovery by him of the failure of one sided jugular pressure to increase the spinal fluid pressure in case of thrombosis of that jugular, evidently unaware of the work of Tobey and Ayer (*Archives of Otolaryngology* **2**:50 [July] 1925).

BACTERIOLOGY OF OTOGENIC MENINGITIS. H. NEUMANN, Ztschr. f. Hals-, Nasen-u. Ohrenh. **12**:165, 1925.

The author reports 119 cases. One hundred and one were monobacillary, eighteen polybacillary, of which only one followed acute ear trouble. Of the seventeen polybacillary cases which followed chronic ear suppuration, fifteen had more than one intracranial complication, as did thirty-four of the chronic with monobacillary infection and sixteen of the acute.

Of the monobacillary the principal offenders were: *Streptococcus pyogenes,* forty-five times; *Streptococcus mucosus,* twenty-two times; *Diplococcus pneumoniae,* sixteen times; *Staphylococcus pyogenes,* four times; *Obligatory anaerobe,* three times. Diplostreptococcus and *Streptococcus lanceolatus,* two each; gram-positive cocci, gram-negative cocci, coli commune, pyocyaneus, 1 each.

Neumann believes that complications occur only during acute exacerbations, and reports the case of a patient with discharge from the ears in which two neurologists had diagnosed temporal lobe abscess and on whom he refused to operate because of absence of acute symptoms in the ear. The patient made a good recovery.

This author believes bacterial differentiation will prove valuable in the serologic treatment of meningitis, which he thinks is our best hope for the future.

VALUE AND LIMITATIONS OF LIQUOR DIAGNOSIS IN OTORHINOLOGY. A. KNICK, Ztschr. f. Hals-, Nasen-u. Ohrenh. **12**:172 (Nov.) 1925.

Beginning leptomeningitis, brain abscess, collateral meningitis with sinus thrombosis and pachymeningitis are shown early by increased cell count and globulin, although the latter three are not excluded by their absence, and can be diagnosed by other clinical manifestations. Unless tumor, syphilis or tuberculosis are in question, the other chemical reactions are superfluous (colloidal gold, mastic reactions, sugar test, etc.). Cisterna puncture has increased the usefulness of cell count and globulin test, showing earlier and greater changes than lumbar puncture so long as the inflammatory process is increasing. Lumbar fluid may be normal or uncertain when cisterna shows definite pathology, and complications cannot be definitely excluded by fluid examination without it. When the process is on the wane, the lumbar fluid may show greater cell count than cisterna, probably due to sedimentation. In labyrinth involvement the cisterna puncture is especially valuable for early evidence of meningeal invasion, while convexity meningitis and deep seated brain abscesses may not show changes in fluid at lumbar level until the pathology reaches considerable magnitude.

THE QUESTION OF LUMBAR PUNCTURE IN BRAIN ABSCESS AND OTHER BRAIN COMPLICATIONS. G. V. T. BORRIES, Ztschr. f. Hals-, Nasen-u. Ohrenh. **12**:186 (Nov.) 1925.

The presence of pleocytosis without positive culture may be due to uncomplicated meningitis or to brain abscess. Borries believes the following a practical clinical rule: If cerebral symptoms have been present for several days and lumbar puncture shows only slight changes, the probability is against leptomeningitis and in favor of brain abscess or other complication; especially if increase of intracranial symptoms occurs with improvement in spinal fluid.

CLINIC OF CHEMOTHERAPY. G. CHAROUSEK, Ztschr. f. Hals-, Nasen-u. Ohrenh. **12**:189 (Nov.) 1925.

Twenty-one cases are reported; hexamine, an acridine dye, proteins, caffeine and amidopyrine were the drugs used, the two latter to dilate the cerebral vessels so as to enhance the effect of other remedies used intravenously. Hexamine was used, 5 cc. of 40 per cent solution. Chemotherapy is useless unless adequate surgical drainage is also obtained. It then can help to throw the balance in favor of the patient with blood stream infection.

One meningitic patient with positive culture of a saprophyte recovered; no other recovered if viable bacteria were found in fluid. Sinus thrombosis and sepsis were favorably influenced.

A number of patients had a variable spinal fluid at the same puncture, indicating lack of diffusion of its constituents.

DISCUSSION OF THE FOREGOING PAPERS ON MENINGITIS. Ztschr. f. Hals-, Nasen-u. Ohrenh. **12**:202, 1925.

Hinsberg recommended that each try out one method. In addition to surgical drainage, he has used for the last six years 12 grams of hexamine per day. There were sixty cases of meningitis with twenty recoveries (spinal fluid culture not stated). Twice in looking for a cerebellar abscess he has opened the cisterna lateralis, which resulted in enormous flow of liquor. One patient died in two days of meningitis spreading from the dura incision; the other recovered from the meningitis greatly weakened by the profuse three weeks flow of fluid. He thinks the incision dangerous, and recommends opening the cisterna through the porus acusticus in labyrinth cases only.

Hayman: This investigator has had ten years of observation of necropsies in Breslau, covering 35,000 cases. Thirty-five hundredths per cent were due to otogenic meningitis, of which 0.18 per cent were uncomplicated. This percentage agrees closely with old statistics, and indicates failure of modern therapeutic resources, including surgery. On the other hand, figures for sinus thrombosis are 0.1 per cent against 0.15 to 0.2 per cent in old statistics.

His own clinical material of forty meningitis cases showed 31 per cent recoveries under various treatments. Sinus thrombosis showed 84 per cent and brain abscess 50 per cent recoveries. Prognosis in meningitis is in reverse proportion to the cell count, but patients with from 8 to 9,000 cells and hemolytic streptococci occasionally recover. On the other hand, patients with sterile fluid died.

Suggesting intracranial pus infection as against noninfectious lesions and tuberculosis, is a neutrophil count of over 10,000, absence of eosinophils,

increased iodin reaction and sudanophilia. Reappearance of eosinophils and increase in lymphocytes, especially if the latter are above the neutrophils, is of good prognostic import. The most favorable form of meningitis is that in connection with sinus thrombosis; the next that with labyrinthitis. Meningitis combined with brain abscess and when there is no macroscopic evidence of the route of extension, is of bad import. All but one of the latter type occurred in nonpneumatized mastoids, and may be due to the aberrant vessel communications described by Witmaack.

Operative drainage is useful only when done early and in localized cases. According to their experience, the results were the same with or without chemotherapy.

He thinks further study of spinal fluid compared with the pathology and results of both chemotherapy and surgical therapy offer some hope of progress.

Runge: This investigator experimentally produced meningitis by injection of staphylococcus bouillon culture into the cisterna of dogs. Some of the dogs also had double the amount of an acridine dye solution injected at the same time or immediately thereafter. The therapeutic results were nil, although he determined that the injected fluids washed freely both convexity and base of the brain.

M. Meyer: Of most importance in diagnosis is the examination of the patient, and not alone the spinal fluid. Lumbar puncture is not without danger, especially in brain abscess, but in the therapy of meningitis it stands next to surgical drainage of the primary focus.

H. Claus: This investigator retracts his statement that he has seen two deaths from an acridine dye. Both patients were treated by prolonged irrigation from dural incision in temporal lobe to lumbar needle, and death may have been due to medulla compression.

Hoelzel: The meninges are the serous cranial cavity part of the lymphatic system, and should be handled through the lymphatic system. Here follows a speculative dissertation which does not lend itself to abstracting, winding up with the therapy, which is applied at the origin of the lymphatic system, namely, the bowel and its glands, including the liver, and consists of flushing clean and leaving for absorption a liter of cool, fresh, well oxygenated water. This he believes the first essential next to surgery. He deprecates the withdrawal of any spinal fluid, and says his treatment makes antibacterial treatment superfluous.

Manasse reports two fatal cases of meningitis resulting from peridental membrane suppuration, followed by sepsis and meningeal involvement.

Kobrak: The laboratory findings are as yet insufficient for a clinical picture, however we should not give up trying to diagnose thereby so clear a clinical entity as serous meningitis. In the etiology of serous meningitis, we should take into account not only the exogenous factors (degree of bacterial virulence, toxicity) but also endogenous ones (toxic affinity of the meninges and nervous system, the exudative diathesis and its related neuropathy).

Voss: This investigator reported a fatal case of meningitis with persistent sterile fluid. None such occurred in the group reported by Neumann. The first essential in meningitis is prophylaxis, and with this in view he advocates operative approach in cases of skull fracture involving the ear or nose, more particularly if there is acute or chronic inflammation present in these areas. In regard to the complete drainage of spinal fluid, he calls attention to the good results from this treatment in the epidemic form and in typhus.

Brock: This investigator quotes Hayman's statement of 31 per cent recoveries in meningitis, whether after acute or chronic ear trouble. He has seen but

one recovery after acute ear trouble, but several following chronic suppuration. He agrees with Hayman that meningitis without macroscopic connection with the original focus has a much worse prognosis.

Schmidt-Hackenberg: This investigator reports fatal meningitis following furuncle behind the auricle, with erysipelas, the infection spreading through the emissarium to the sinus, causing thrombosis of this and both cavernous sinuses.

Herzog: Because of injury to the already damaged brain by ether, this investigator recommends local anesthesia as giving the patient a better chance than many chemotherapeutic procedures.

Grahe: This investigator has demonstrated histologically the spread of infection through the perpendicular vessels connecting the pneumatic spaces with the cranial contents as described by Witmaack. He also demonstrated such vessels in the sinus wall.

Goerke: This investigator has seen no ill result from profuse cisterna drainage. He believes it establishes drainage before the infection becomes disseminated.

Zange: Even with freely communicating subarachnoid space, as shown by Knick, the liquor varies at various levels, and most certainly in case of a block anywhere. Therefore, the importance of his and Keller's combined cisterna and lumbar puncture. This difference makes improbable the diagnosis of various types of meningitis by the fluid examination alone. He prefers the term hydrops cerebrospinalis for increased fluid without increased cell count.

Neumann: This investigator calls attention to the fact that the placques of exudate on the brain substance mentioned by him may be located anywhere regardless of paths of extension. He agrees with Hayman that the healing coefficient of meningitis has not been altered perceptibly. He again calls attention to the importance of defining the exact type of meningitis meant when discussing the subject.

Knick: This investigator has seen a pyocyaneous meningitis follow fistula into a ventricle resulting from brain prolapse. However, in meningitis with positive bacterial culture, cisterna drainage is justified. He has performed this, combined with through irrigation through the lumbar puncture. Even though lumbar puncture may not show changes in the fluid at times in cerebral lesions, as a rule it will show increased cell count and globulin when the intracranial lesion is still histologically definitely localized, and thus give early information. One drop in the counting chamber, and another for the Pandy test are sufficient at the bedside; therein and in its clinical practicability lies its value.

LEWY, Chicago.

MENINGITIS SEROSA ACUTA AFTER OTITIC LABYRINTHITIS. GEORGE BOENNINGHAUS, Ztschr. f. Hals-, Nasen- u. Ohrenh. **13**:1 (Oct. 30) 1925.

The patient, a man, aged 25, had suffered since his youth from a middle ear suppuration on the left side. In the middle of May, 1924, after tonsillitis, he suffered from pain in the left ear, dizziness and vomiting. When he was admitted to the hospital, there was complete deafness, absence of caloric reaction in the left labyrinth and a fine nystagmus especially when looking to the right. There was also a facial paralysis on the left side. June 2, the radical operation was performed and the labyrinth was freely opened. No cholesteatoma was present but pus under pressure was found in the antrum. The horizontal semicircular canal showed a fistula. The patient made a good

recovery. The eye could be closed soon after the operation. June 20, the patient suffered from fever and did not feel well. The pulse rate declined to 40 and instead of fine labyrinthian nystagmus to the right, a coarse rotatory nystagmus to the left side set in, pointing to an irritation of the center of nystagmus in Deiter's nucleus in the pons. The patient became somnolent and uncleanly. June 25, the dura at the posterior surface of the pyramid was exposed and a small extradural abscess opened. The dura was red and thickened. The cerebellum was punctured through the dura in various directions, also from an opening behind the sigmoid sinus. Neither pus nor serum was found. The dura was incised from the inner meatus to the sinus, and the dry and hard cerebellum which did not pulsate was deeply incised without any result. The next morning the patient felt well. The pressure pulse had disappeared. The nystagmus to the diseased side disappeared slowly. The dressing showed that much liquor was discharged. When the first dressing was done, a medium sized prolapse of the cerebellum was noticed. After a few dressings it disappeared. The ear suppuration continued on account of a sequestration of the whole floor of the labyrinth. A new prolapse of the cerebellum appeared in the beginning of August, 1924, when the wound behind the ear had almost healed. The patient felt well. The prolapse increased in size gradually and could be seen in the meatus. A horizontal scar could be observed proving that the dura prolapsed. This meningocele grew so much that it filled the whole very wide ear canal up to 1 cm. from the outer opening. The ear suppuration continued through the whole winter. On March 15, 1925, the sequestrum was removed with a hook. Three days afterward the meningocele burst and liquor discharged for fourteen days. The patient felt well all this time. After two weeks the scar healed. This process recurred several times. Since June 20, the patient, a chauffeur, does not drive and his ear is at rest. He feels well. It must be assumed that the extraction of the sequestrum and the driving of the automobile had created an irritation on the meningocele which led to serous meningitis and to a rupture.

Abscess in the Frontal Lobe of the Brain Following an Otogenous Thrombosis of the Lateral Sinus. R. Bleyl, Ztschr. f. Hals-, Nasen- u. Ohrenh. **13**:16 (Oct. 30) 1925.

The patient of Bleyl, a man, aged 46, presented himself March 24, with severe pain in his right ear and on the right side of the head. In 1915, he was in the war and was buried under débris. Afterward, he suffered for a short while from middle-ear suppuration. A general weakness of the nerves, headache and an excitable condition remained. The ear had been dry until March. On account of mastoiditis an operation was performed on April 8. The lateral sinus was exposed and looked healthy. After the operation the general condition improved and the temperature went down, but rose to 104 F. in a few days. Therefore, on April 14, the lateral sinus was opened, the jugular vein tied, and the jugular bulb cleared. The temperature remained high. There was pain on the left side of the chest, cough, expectoration, dulness in the region of the left lower parts of the lung, and signs of bronchitis. These symptoms disappeared gradually. The temperature decreased. On April 18, the patient vomited, suffered from pain in the abdomen, head and neck, and the temperature rose to 102.6 F. The patient was apathetic and showed slow cerebration. On April 21, the slow pulse rate pointed to an intercranial complication. The cerebellum was punctured in different directions. No pus was

found. The spinal fluid was under increased pressure and clear. On reaction, after Pandy and Nonne-Apelt tests, the liquor was cloudy and showed an increase in lymphocytes (56), some polymorphonuclear cells, but no microbes. The blood Wassermann was negative. On April 22, sensory disturbances appeared in the left arm especially of a stereognostic nature. On the next day also symptoms of motor disturbances appeared in the left arm and in the left leg, although they were less pronounced. Babinski sign was positive on the left side. There was no nystagmus, no hemianopia and no paralysis of the eye muscles. The pupils were even and reacted tardily. There was an intimation of choked disk. On April 25, the temporal region of the brain was explored without result. The patient died on May 6. In the right frontal lobe of the brain, necropsy revealed a pus cavity from 3 to 4 cm. deep, 6 cm. high, and 10 cm. wide. From the lateral wall of the abscess a much dilated thrombosed vein led to the fossa Sylvii. The vena fossa Sylvii is directly connected with the sinus transversalis through Trolard's vein. It is difficult to decide whether originally a subdural or intrameningeal pus focus existed, which developed into a brain abscess by melting of the brain tissue, or, if the infection was carried into the depth of the brain cortex by small veins of the pia. The few cases published so far allow the conclusion that brain abscesses induced by veins of the pia are mostly located in the cortex of the brain, whereas the metastatic abscesses are located in the brain marrow.

AMBERG, Detroit.

Pharynx

TONSILLECTOMY AND ADENOIDECTOMY IN SELECTED CASES DURING THE PERIODS OF PRIMARY AND SECONDARY INFECTIONS. FREDERICK T. CLARK, Ann. Otol., Rhinol. & Laryngol. **34**:491, 1925.

This procedure is considered by the author to be entirely rational and conservative. It is recommended in certain types of acute angina, with threatening or developed atypical peritonsillar abscess and marked glandular involvement. Especially in cases of acute otitis media in which there are pathologic tonsils and adenoids present, their prompt removal is advocated as one of the first considerations, both to cure the otitis and to abort a surgical mastoiditis. That infected tonsils and adenoids in children are responsible for a large percentage of the cases of bronchitis and bronchopneumonia, as well as sinus infections, coughs and colds, is a well established fact, and in all such cases the removal of the tonsils and adenoids is recommended. The operation should also be considered in suspected or present juvenile tuberculosis. In view of the inference that the tonsils and adenoids are the chief foci of infection in scarlet fever, diphtheria and measles, it is only logical that their removal be practiced not only as a prophylactic measure but as a rational means of shortening contagion during acute attacks in selected cases, and to prevent the frequent otitic and nephritic sequelae. In unaccounted for hematuria, albuminuria, acute nephritis or pyelonephritis, the tonsils and adenoids should be suspected as the focus of infection, and if not above suspicion, prompt tonsillo-adenoidectomy should be done to prevent structural changes in the kidneys.

The author reports a series of successfully operated cases, and he firmly believes that such a surgical procedure, in selected subjects, is not attended by grave dangers to the patient but is a procedure of value to both the patient and the surgeon.

SNAPP, Grand Rapids, Mich.

Larynx

THE TREATMENT OF LARYNGEAL TUBERCULOSIS BY THE DIRECT INJECTION OF TUBERCULIN INTO THE LARYNX. FRANK R. SPENCER, Ann. Otol., Rhinol. & Laryngol. **34**:424, 1925.

Many methods and procedures, both medical and surgical, have been devised for the treatment of laryngeal tuberculosis. A number of these are reviewed by Spencer, giving briefly their advantages, disadvantages, and the results obtained in each. The author also describes a new method, namely, the direct injection of tuberculin into the larynx, which has been tried in a limited number of cases with good results. It is being used cautiously by beginning with 0.1 of a milligram of old tuberculin and gradually increasing the dose if the preceding one has been well tolerated. An interval of two to six weeks between injections is an additional safeguard. The injection is made at the point of greatest swelling after cocainizing the larynx. The point of the needle should penetrate deeply enough to reach the center of the tubercle if possible. A submucous injection is less desirable. Small doses and in small volume is best, not more than 0.5 to 1 c.c. being given at one point of injection. A large dose is apt to produce a severe reaction in the larynx, with more or less severe general reaction. The author's prime reasons for making the injection directly into the larynx are, first, to place it where it is needed most, and second, to avoid the general reaction. It is the stimulation from the local and focal reaction combined which is desirable. This method should not be used if either the pulmonary or laryngeal disease is far advanced, and patients with a temperature above 100 F. are not suitable subjects for injection.

SNAPP, Grand Rapids, Mich.

SINGING AND SPEECH BREATHING IN ACUTE LARYNGITIS. EMIL FROESCHELS, Ztschr. f. Hals-, Nasen- u. Ohrenh. **13**:7 (Oct. 30) 1925.

If a patient with a disturbance of the singing or the speaking voice is examined, the singing and speech breathing is not normal, as a rule. A pneumogram gives a bizarre picture. Paresthesias in the throat and trachea disappear sometimes if breathing is improved. Disturbances of the motility of the muscles of the larynx and sensory disturbances of the larynx can produce disturbances of the breathing innervation. Froeschels pneumographed twelve patients with acute laryngitis. Ten of the twelve patients used more breathing excursions during the course of acute laryngitis than in days of health, and they used more time to sing a song or speak a prayer than after recovery. Only two patients did not breathe more frequently and did not use more time. These were trained singers. Froeschels' investigation shows two symptoms which accompany an acute laryngitis while singing and speaking, a retardation in the course of these functions and an increase in the number of inspirations. The latter phenomenon points theoretically to a stronger expiration. This is confirmed by the curves which show a very rapid decline of the expiration compared with that after recovery. Breathing while at rest does not show any increase of the respiratory movements or an acceleration of expiration. This shows that the disturbance is confined to a coordination of respiration with voice production (respectively, articulation), and proves that an acute disease of the larynx can be accompanied by anomalies of breathing while speaking and singing. These disturbances correspond with those which are observed in functional diseases of the voice, namely, increase in the number

of inspirations and acceleration of expiration. This allows the probable conclusion that disturbances in breathing can occur secondarily in functional disturbances of the voice. A connection between the single symptoms which could be established by laryngoscopy and between the pneumographic pictures could not be established. Only the common basis of all these symptoms, namely, an inflammation of the larynx, may be assumed to create the disturbances in breathing. Investigations are under way to study the breathing while speaking and singing in subacute and chronic laryngitis.

Two New Small Technical Devices for Laryngologists. Theodor v. Liebermann, Ztschr. f. Hals-, Nasen-u. Ohrenh. **13**:77 (Oct. 30) 1925.

A belt of special device is placed around the neck of the patient, and fastened with hooks attached to an elastic thread, to both joints of Whitehead's mouthgag, respectively to the serrated parts, before starting the narcosis. The mouthgag is not opened before the patient is anesthetized. The appliance prevents the untimely removal of the mouthgag by the patient. The second device is a modified powder blower, similar to the instrument of Wagener, consisting of a container with two openings in the cover, one for the afferent and one for the efferent tube. The afferent tube is connected with a double balloon. A pinchcock releases enough air at the desired time to insure a satisfactory air current. The sudden release of the air current permits the use of mixtures of heavy and light powders, that is, preparations of starch, talcum, or boric acid powder. The author states that his appliance is superior to an ordinary powder blower because it prevents the ejection of large masses which prove irritating. Only one hand is used to hold the powder blower. The unbreakable and pliable attachments for the nose and the larynx can be boiled.

Roentgen-Ray Injury of the Larynx. W. Tonndorf, Ztschr. f. Hals-, Nasen-u. Ohrenh. **13**:1, 22 (Oct. 30) 1925.

Marshik, Beck and Rapp, Halberstaedter, v. Hofmeister, Juengling, Koenigund Schmitz have reported injuries of the larynx by roentgen rays. Three stages are differentiated, the early reaction, the roentgen reaction proper, and the late reaction. Immediately following irradiation, an early reaction may set in in the hypopharynx and larynx. Disturbance of the secretion of saliva (salivation or a sensation of dryness) and hoarseness may appear. It is a harmless and quickly disappearing process. The roentgen reaction proper usually sets in from three to four weeks afterward. Changes of the mucous membrane are noticed, with more or less inflammatory swelling and edema. Killian and Marshik have seen a coating in the larynx resembling a diphtheritic coating. This roentgen reaction proper seems to disappear, as a rule, spontaneously and without lasting results. It may lead however, as a case of Marshik showed, to a grave condition, the late reaction. The late reaction appears only after six, twelve or fifteen months. The late reaction is characterized by grave symptoms of degeneration of the soft parts of the throat, by perichondritis, ulceration and sequestration of cartilage in the larynx, and in the majority of cases has led to death. Tonndorf describes a case in point. The patient, a man, aged 22, said that he was treated five and one-half years prior to examination, four times with roentgen rays on account of lymphomas on the left side of the throat. The treatments took place at intervals of two weeks. The patient stood the first three treatments well. Two weeks after the fourth treatment,

symptoms of burns occurred in the skin of the throat. Large ulcers developed which healed after several weeks. In place of the healed ulcers, telangiectasis appeared. The patient reported that his voice had become weak and that it tired quickly, but he was not hoarse. This man was 170 cm. tall (5 ft., 6 in.), but the circumference of the neck was only 30 cm. In the region of the telangiectasis the skin was tense, hard and attached to the deep layers. It could not be raised. The vocal cords showed the same telangiectasis as the skin. The muscle apparatus of the inner larynx worked well, but the outer muscle apparatus was cicatrized. The author pleads for a dependable system to measure the dosage of irradiation. Comparative physical measurements have revealed the uselessness of the skin unit dosage as a unit. Martius and Grebe showed that in fourteen German clinics the unit varied from 1 to 4, and in clinics including American clinics from 1 to 10 (Solomon). That means that in one clinic the treatment was from four to ten times as severe as in others in cases at the extreme end of the list, but the impression prevailed that the strength of the dosage was the same. Behnken has worked out a normal measure "R." A standard measuring apparatus, an ionization camera, is to be used. Portable measuring appliances can be standarized and continually controlled. By this means the dangerous hypoirradiation and hyperirradiation can be avoided, and the patient can be furnished with a correct report of the dosage when he changes physicians.

AMBERG, Detroit.

Nose

THE OCCURRENCE OF FUSIFORM BACILLI AND SPIROCHETES IN PUTRID ETHMOIDITIS. I. PILOT and F. L. LEDERER, Ann. Otol., Rhinol. & Laryngol. **34**:366, 1925.

The authors report two cases of putrid ethmoiditis in which fusiform bacilli and spirochetes were found. Morphologically, the spirochetes were of the Vincent's type and not those of syphilis. The organisms did not appear in pure culture, but were associated with various pyogenic bacteria. The striking characteristic of the infection of the ethmoid cells in both instances was the foul character of the pus. The discharge from typical cases of ozena was examined in several instances for these organisms, with negative results. The authors believe it possible that fetid discharge from the nose may not always be true ozena but due to fusospirochete infection of the sinuses. They make a plea for early recognition of such conditions as they may be influenced by arsenical therapy in addition to surgical measures.

SOME OBSERVATIONS ON CERTAIN FORMS OF CHRONIC SINUSITIS. ROSS HALL SKILLERN, Ann. Otol., Rhinol. & Laryngol. **34**:415, 1925.

The cause of chronicity in sinus infections depends on many factors, which are listed by Skillern in the order of greatest importance as follows: 1. Interference with normal aeration and drainage. This must be divided into (*a*) natural and (*b*) acquired. To the natural causes belong the anatomic peculiarities, such as, (1) a deviated nasal septum, particularly high up, thus causing the nasal passage to be extremely narrow on that side, and wedging the middle turbinate against the bulla and lateral wall of the nose; (2) a long and narrow nasofrontal duct, which would become occluded at the slightest swelling of the lining mucosa, thus closing the frontal sinus like a cork in the neck of a bottle; (3) deep recesses and partial septums in the sinus cavities, thus predisposing to the retention and stagnation of contained secretions; (4) large

rolled out middle turbinates, hugging close to the lateral nasal wall, thereby occluding the normal drainage passages; (5) in the case of the maxillary sinus, roots of teeth extending into the floor of the antrum.

To the acquired causes belong: (1) Repeated attacks of coryza, causing a chronic thickening of the mucosa, with gradual interference to drainage and ventilation; (2) inflammatory changes in the sinus mucosa, causing an inhibition to the movement of the cilia, thus preventing them from ridding the sinus cavity of the invading micro-organisms; (3) type of infecting organism, which is usually the *Staphylococcus aureus* or the streptococcus.

The ordinary case of chronic frontal sinusitis usually results from repeated attacks of so-called cold in the head, which may or may not have been traced to an earlier attack of influenza. Such conditions usually clear up by removing the causative factors of the chronicity, such as a deflected septum or a cystic middle turbinate. The author feels that it is far better to seek out these obstructions to aeration and drainage and remove them than to try to lavage the sinus with all sorts of old and new antiseptics. He believes the external operation rarely necessary; practically all chronic infections of the frontal sinus clearing up from intranasal operative procedures as well as from more radical measures.

Chronic maxillary sinusitis may result from an extension of infection following an acute infection in the nose and throat, from an infected tooth or from an occlusion of the mouth of one or more mucoid glands; the latter condition causing a so-called mucocele. There is a wide divergence of opinion as to the percentage of cases due to infected teeth. The author believes that something less than 20 per cent are caused in this way. Needle puncture and irrigation are sufficient to clear up a large number of these cases. Those not responding to this method should be given the benefit of intranasal drainage before deciding on the radical operation.

Infections in the sphenoid sinus may be quite difficult to diagnose. Chronic inflammation of this cavity may extend all the way from a low grade, almost nonsecreting and symptomless catarrh to a profuse purulent discharge, with all sorts of pains and aches in near and remote portions of the body. Vague occipital headaches often result from the hyperplastic type of sphenoiditis. Good results are usually obtained by free drainage.

SNAPP, Grand Rapids, Mich.

THE MASTICATORY FUNCTION AND THE DEVELOPMENT OF THE NASAL CAVITY. CORRADO D'ALISE, Arch. ital. d. otol. e laringol. **36**:501-506, 1925.

D'Alise recalls that, from time immemorial, the mouth and the nose have been treated as if there were nothing in common between them. This is a grave error, and has contributed much to the delay in recognizing the harmonic unity of the body as a whole, not only anatomically but also physiopathologically and clinically. The author emphasizes that in paired organs, in order to secure a normal and symmetric development, an equally intense functional activity is required in each organ (or in the two sides of an organ); for example, for the proper development of the nasal cavity and the face there must be normal and efficient mastication on both sides, which is possible only when the masticatory function of the temporary and the permanent teeth is preserved intact. In children, if mastication is suppressed on one side or on both, for even a few

days, the injurious habit of chewing only on one side or of masticating the food insufficiently will be acquired, with the inevitable result that an asymmetrical or defective development of the face will ensue.

WOLCOTT, Chicago.

PRIMARY ACUTE FETID SUPPURATIONS OF THE MAXILLARY ANTRUM. KARL M. MENZEL, Ztschr. f. Hals-, Nasen-u. Ohrenh. **13**:81 (Oct. 30) 1925.

Menzel reports seven cases in point. He made histologic investigations after radical operation, and found certain characteristic destructive processes. They belong to a class of cases of primary suppuration of the maxillary antrum, characterized by an onset of fever, violent, atypical pain and a fetid secretion. These destructive processes of the mucous membrane are seen as hemorrhagic necrotizing inflammation, with fibrinous exudation into the partly necrotic tissue and into the surface in the shape of membranes. Such forms of inflammation have been described by pathologic anatomists almost exclusively. In some instances, a defect is created by destruction of the mucous membrane of the bone. In this region, the border of the cavity is formed outwardly exclusively by the soft parts. If these are affected, the "sinusitis exulcerans atque abscendens" of Killian is present. This is not to be looked on as chronic, but as the last stage of an especially intensive primary acute suppuration of the maxillary antrum. The dental etiology is not to be considered in Menzel's patients. The acute primary inflammations are classified as follows:

1. Acute catarrhal inflammations.
2. Acute suppurative inflammations, (*a*) with odorless secretions and moderate degree of inflammatory changes of the mucous membrane; (*b*) with fetid secretion and necrotizing inflammation of the mucous membrane alone, or simultaneously, also with that of the osseous wall. This may lead to a perforation to the outside.

AMBERG, Detroit.

Miscellaneous

THE PRESENT STATUS OF ELECTROTHERAPEUTIC MEASURES USED IN THE PRACTICE OF OTOLARYNGOLOGY. JOSEPH C. BECK and HARRY L. POLLOCK, Ann. Otol., Rhinol. & Laryngol. **34**:403, 1925.

In a review of the various electrotherapeutic aids in otolaryngology, the authors discuss the merits and demerits of the many methods. Glowing results are frequently reported by an author using some one of the measures, but when the same device is used by others the results are not good. One cause for failure is the limited information most medical men have about electrical appliances, while another cause lies in the fact that the manufacturers of these various devices, in order to effect a sale, usually claim highly successful results and cures, and the purchaser, in order to reimburse himself for the original outlay, is often tempted to treat all sorts of varieties and conditions.

The high frequency current, that is, one having such a high rate of alternations that living tissues do not attempt to contract under each impulse, is employed in two forms, namely, the general and the local. The former is never used in otolaryngology excepting for a general metabolic action. In local application vasodilatation and hyperemia occur, but the authors have seen no benefits and do not recommend its use.

Good results are reported from the use of leukodescent heat in acute sinus infection, cellulitis, furuncles, etc., the effect being purely palliative.

Diathermia is divided into two classes: (1) diathermia, and (2) electrocoagulation or surgical diathermia. The former has been found valuable as a sedative treatment in neuralgias and in stimulating absorption of chronic inflammatory products, while the use of the latter has been discontinued, surgery giving far better results.

Fulguration and the use of the electrocautery, so far as effecting a cure in malignant growths is concerned, have been failures, and hence have been discarded by the authors. They believe that endothermia or radio frequency is worthy of a trial. The electric pulsator has been used in many cases, but not a single patient was benefited by this treatment in itself. The various forms of vibrators, as well as electrolysis have also been abandoned.

The actinic rays have proved to be of much value in the treatment of hyperesthetic rhinitis, as well as of furunculosis of the ear, nose or face. They proved a failure, however, in cases of suppurative sinus disease, both preoperative and postoperative, as well as in cases of asthma and hay-fever.

The roentgen ray is extremely valuable in both diagnosis and treatment, but must be used cautiously and in conjunction with surgery in most cases.

In conclusion, the authors believe that electricity and rays of the various types have a distinct value in our therapeutic armamentarium, but their action must be thoroughly understood. The subject must be selected, and it must be remembered that one type or one machine is not a panacea for all ailments.

MEDICAL REMEDIES FOR THE CONTROL OF HEMORRHAGE. SAMUEL G. HIGGINS. Ann. Otol., Rhinol. & Laryngol. **34**:474, 1925.

A marked reduction in the coagulation time has been found to occur following the injection, either intramuscularly or intravenously, of sodium citrate solution. It may be injected during operation, but more preferably is given about a half hour before; say, at the time the narcotic is administered, if one is employed. That it is of value when used during an operation is shown in one of the author's cases in which the citrate was injected during the course of a radical mastoid operation in a case of unusual, though not serious, oozing from the mastoid bone. Much less sponging was required following its use. The effect is only temporary, however, the coagulation time gradually returning to its original figure within about twenty-four to thirty-six hours following injection. The injections may be repeated in thirty-six hours if necessary.

The solution used is sodium citrate, chemically pure 30 per cent., sterilized by boiling. The dose given is 30 c.c., and the site of injection is the buttocks. The skin is sterilized with tincture of iodin, and with a 3 inch needle 3 c.c. of a 1 per cent. procain solution is injected into each buttock. Three minutes are allowed to elapse, and then 15 c.c. of the citrate solution is injected into each buttock, directly in the same area as in the injection of procain. The procain tends to diminish to a great degree the pain, which is temporary only.

SNAPP, Grand Rapids, Mich.

NEW EAR AND NOSE SPECULA. MAXWELL WALTZ, Ztschr. f. Hals-, Nasen-u. Ohrenh. **11**:587 (Sept. 8) 1925.

Waltz devised new ear-and-nose specula in order to have a larger field of operation at his disposal. He also devised some special chisels to be used with a universal handle. He used some of these instruments for the radical mastoid operation, from the outer meatus, in selected cases. The halves of the ear

speculum are gradually opened like a fan. The ear speculum holds itself in place, thus allowing the surgeon to use both hands. Another model, with a larger diameter of the halves is to be employed if the electric burr is used, to remove the outer wall of the epitympanum (von Eicken). The new ear specula can be used when performing a paracentesis, or in the treatment of furuncles in the outer meatus, or in after treatment of the radical mastoid operation. The new nasal specula serve to obtain a larger field of operation for intranasal operations of the frontal sinus, the ethmoid cells or the lacrimal sac. They are devised for the right and the left side differently. A long upper wing is introduced directly under the middle turbinate, directly toward the lateral surface of the same, the short shank toward the apertura piriformis. When the shanks are opened, the middle turbinate is pushed toward the septum, and makes the field of operation more accessible for surgical interference with the lacrimal sac and the frontal sinus (removal of the agger nasi). The new nasal speculum holds itself in place. Another model can be employed like an ordinary Killian nasal speculum. A fourth instrument can be utilized for operation of the sphenoidal cavity and the sella turcica. A small electric lamp can be attached at the end.

PROGRESS IN LIGHT TREATMENT OF THROAT, NOSE AND EAR DISEASES. HANS LEICHER, Ztschr. f. Hals-, Nasen-u. Ohrenh. **13**:27 (Oct. 30) 1925.

The indiscriminate application of light rays, the insufficient knowledge of the biologic effects, and the frequently applied wrong dosage have discredited the new therapeutic method with many. The newest development of light therapy shows that the effect of ultraviolet rays on the whole body is just as essential for the favorable influence on diseases of the throat, nose and ear, as is the local irradiation. Leicher not only reviews critically the contributions during the last four or five years, but reports some investigations which have not yet been reported. Leicher treats exhaustively a number of conditions and methods of treatments which must be read in the original. It is sufficient to mention some of the headings, subheadings and some of the contents of the article. (Although it is rather arbitrary to select just a few of the many observations, the reviewer does not do it because the others are less important, but only because of lack of space.)

1. The necessity of an exact dosage of light rays. 2. The faults and defects of the hitherto employed dosages and designations of the dosage. 3. Proper designation of the doses and the dosage based on a biologic basis. 4. Biologic light effect on the whole body. 5. Effect on the calcium content of the blood. 6. Effect on the blood protein bodies. 7. Effect on the blood sugar and the carbohydrate tolerance. 8. Effect on the cholesterin contents of the blood. 9. Effect on blood pressure. 10. Effect on blood coagulation and blood regeneration after loss of blood. 11. Immune biologic effects. 12. Light effect and protein therapy. 13. Local light treatment of the throat, the nose and the ear. 14. Light treatment of tuberculous diseases of the throat nose and ear.

A number of weighty conclusions for the practice must be observed. 1. The dosage in total irradiation (of the entire body) of tuberculosis must be chosen so that the protecting forces are gradually strengthened, but that no exhaustion of the cell function results. It makes no difference whether the sun, the Finsen lamp or other sources of light are used which are richer in ultraviolet rays of short wave length. 2. Too small a dosage is useless, just like in the protein bodies therapy. Too large a dose or a dose rising too quickly leads,

as in the protein bodies therapy, to disagreeable general symptoms (fever) or to injurious focal reactions (swelling and pain in the larynx, hemoptysis etc.). 3. It is the object of a general light treatment of tuberculosis to obtain a proper focal reaction. The required light dose cannot be determined after purely physical or chemical principles, but must be adapted to the sensitiveness of the individual to light. A trial irradiation is absolutely necessary if ultraviolet rays of short wave length are used (Bach-and Jesionek-Alpine sunlight). A trial irradiation may not be necessary if a Finsen lamp is used with careful dosage, although a more correct dosage can be obtained also in this instance by a trial irradiation. 4. Rise in temperature to about 100.6 F. in the axilla is no contraindication for light treatment for tuberculosis. Naturally, a light treatment should be begun, if possible, when the patient is free from fever. The dosage must be carefully watched with patients with fever. The dosage at the beginning should be one fifth to one fourth of the dose which caused a just visible erythema at the trial irradiation. Otherwise, in the beginning it may be one third or one fourth of the dose. As the treatment should be regular and should last for weeks and months, the sun irradiation cannot be used in all localities. Therefore, artificial sources of light should be used, although the results of Bernhard and Rollier are recognized.

Fourteen years ago, Reyn introduced the total irradiation with carbon arc lights as a therapeutic measure in tuberculosis. Strandberg has repeatedly shown that it is possible to cure clinically, tuberculosis of the larynx with the aid of the total irradiation. Yet he pointed out that it is of advantage to use also a proper local treatment (galvanocautery, excision) but only after the general light treatment has improved the general condition of the patient. Of 147 patients of Strandberg, suffering from tuberculosis of the lung and larynx, among whom were grave and very grave cases, seventy-nine (53.7 per cent) presented a clinically healed larynx, fourteen were still under the treatment, and of these eleven were improved. The other fifty-four did not continue treatment for nonmedical reasons. Of these, thirty showed improvement.

The light treatment of nontuberculous diseases of the nose, throat, and ear: (*a*) nonspecific suppuration of the middle ear in general tuberculosis and scrofulosis; (*b*) otitis media in rickets. Leicher observed the course of otitis media in twelve nurslings suffering from rickets, with careful control of the calcium and phosphate contents while they were treated with artificial alpine sunlight. Of the twelve children, five had a more or less pronounced mastoiditis. Daily irradiations with artificial alpine sunlight were used, besides local and general treatment (moist packing in the meatus, local heat application and general sweatpack). The calcium and phosphate content of the serum, which was in some instances much reduced, became normal, or nearly normal, after from nine to twenty-four days. In the seven patients without mastoiditis, and in three patients with mastoiditis, the otitis media healed after from twelve to twenty-five days without operation. The other two patients with mastoiditis, who had come for treatment relatively late, required a mastoid operation (antrotomy) but recovered quickly. Gyoergy and Gottlieb recommended an increased effect of irradiation in rickets by oral administration of eosin. Children with rickets could be cured in about half the time which was used otherwise, if 0.1 Gm. of crystallized eosin was given per os before irradiation. Gassul had reported previously about the creation of sensibility for ultraviolet light in animals. The mercury quartz lamp, rich in ultraviolet rays of short wave length produces a quicker cure in rickets than the rays of carbon arc

lights or of the natural sun. (*c*) Laryngospasmus (tetany); (*d*) hay-fever, asthma, vasomotor rhinitis. Of twenty-two patients suffering from asthma, seven were improved by general light treatment, fourteen showed no change, one was made worse, so that light treatment had to be discontinued. Of sixteen patients suffering from hay-fever, six showed a marked improvement, ten did not show any change. Of the eleven cases of vasomotor rhinitis, only three were markedly improved (among them two with decreased calcium content), the other eight were not influenced; (*e*) local treatment of tonsils in diphtheria. Hufnagel has seen good results in pharyngeal diphtheria by quartz light treatment. Friedberger and Shoji showed that, in rabbits, by the application of ultraviolet light into the oral cavity, an extremely efficient annihilation of microbes of diphtheria bacilli also takes place. The irradiation with ultraviolet rays is praised lately by American authors as a successful measure with carriers of diphtheria bacilli. According to Donnelly, who used irradiation through a metal funnel, twenty of forty carriers were made free from germs after 1 treatment, sixteen after 2, and four after 3 irradiations; (*f*) the light treatment of erysipelas emanating from the ear, nose or the mouth Czepa saw in 100 cases of erysipelas (mostly of the face) a favorable influence. A strong dose which creates a severe erythema is necessary. Leicher foregoes a trial irradiation in this instance in order not to lose any time. If, with his Jesionek lamp, of a certain age of the burner, two E. M. (unit minutes after Dahlfeld) are required in an individual of an average sensitiveness to light, he uses at the first sitting a tenfold dose, twenty E. M. (that is, five minutes with 50 cm. distance); (*g*) light treatment of otosclerosis. Twenty-eight patients were subjected to total light treatment. Eight patients were observed for six to eleven, ten from eleven to seventeen, six from eighteen to twenty-three, four from twenty-four to thirty months.

The decreased calcium content of the blood serum approached the norm in seventeen of the twenty-eight patients after several treatments. The others were not influenced. After the first total irradiation, frequently a further small decrease of the calcium amount was noticed in the beginning.

Of twenty-eight patients, twenty-five showed a decrease of cholesterin (Berberich). With all twenty-five patients the values approached the norm and sometimes became entirely normal. In the great majority of the cases, although there were no patients with otosclerosis among them, Esslinger and Gyoergy showed that irradiation with ultraviolet light had perceptibly increased the lipoid phosphorus and cholesterin.

Of the twenty-eight otosclerotic patients, two showed an increased amount of blood sugar (over 0.12 per cent). In both instances, a few irradiations decreased the amount. Of the twenty-three patients who exhibited a diminished tolerance against phlorizin, only four showed a better tolerance after four irradiations.

The lability of blood protein bodies (increase of globulin) increased in all cases under irradiation, but was less than before in sixteen of twenty-six patients after irradiation was discontinued.

Leicher will soon publish his conclusions concerning the relation of these findings to the local otosclerotic process. In all cases of tinnitus, the patients spontaneously reported improvement. The little improvement of hearing may be attributed to the decrease of tinnitus. In two subjects a further decrease of hearing took place in spite of light treatment. In the others, the function of the ear remained the same.

In light treatment of ozena, Cemach claims that the bad odor can be effectually combated by endonasal application of quartz light. A special method must be used.

In light treatment of badly granulating and epitheliazing wounds after operation on the ear, a strong dose can be used to prevent exuberant granulation; too strong a dose may cause necrosis. A total light treatment may be employed in patients with a badly granulating wound, to improve the general condition, besides local phototherapy. Leicher states that phototherapy is only one of a series of therapeutic factors, even in diseases in which it is triumphant at times.

AMBERG, Detroit.

Society Transactions

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Oct. 19, 1925

HARRY L. POLLOCK, M.D., *in the Chair*

AURAL QUACKERY AND PSEUDOMEDICINE. Presented by DR. ARTHUR J. CRAMP (Director of the Bureau of Investigation, American Medical Association).

Dr. Cramp discussed quackery and pseudomedicine as applied to otology. His talk was illustrated by lantern slides which displayed the advertisements familiar to some of our publications, as, for example, the "Leonard Ear Oil and Ear Drum," "Aurine Ear Balsam," the "Hear-Well Oil," "Virex Products," "Rattlesnake Oil," etc. The fact that manufacturers of such useless products succeed in a financial way is an interesting commentary on the low level of human intelligence that exists in certain classes of our population.

The lecture included the discussion of the numerous mechanical devices with which these unfortunate victims of incurable deafness are pursued by unscrupulous manufacturers, such as "Actina," the "perfect ozone battery," the widely advertised "Wilson Ear Phone," which has been purchased so extensively by patients suffering from a type of deafness that could not be influenced in the slightest by this or any other mechanical device, "The Morley Phone," the "Mega Ear Phone," the phone sold by Charles Fensky of St. Louis, which is said to be radio actively charged with so-called "Hearium," all of which are equally useless. The misleading claims of the "De-a-fone," first put on the market by the National Acoustic Laboratories, later by the National Deafone Company, changed again to the Electrophone Corporation, now known as the Electrophone, which is being used in the so-called Audio Institute advertised in the Chicago papers as, "hearing restored by the Audio treatments." A device of this kind, a noise producing apparatus, seems the bait suited for people with more intelligence than would nibble at an earphone or ear oil.

Dr. Cramp concluded his lecture with a discussion of the methods pursued by advertisers such as Guy Clifford Powell, E. E. Gardner, G. H. Brenaman, George E. Coutant, the well-known Coffee and last but not least, Muncie, the Brooklyn osteopath, who seems to have developed a faculty of salesmanship that would be invaluable to the seller of fake oil wells or any other gold brick proposition. Muncie "cures" incurable deafness by sticking his finger in the nasopharynx. The patient, under gas anesthesia, does not appreciate the few seconds which it takes to accomplish a feat which any otologist can do without gas, and with very little discomfort to the patient. From reports received from patients, Muncie seems to extract large operative fees, which goes to show that no matter how absurd a proposition is, if one possesses salesmanship, it is possible to reap a financial return.

AUDIOMETRY. Presented by DR. HARVEY FLETCHER, Research Department, Bell Telephone Laboratories.

Dr. Fletcher stated that the Bureau of Standards in Washington, D. C., had promised to undertake the investigation of the various aids to hearing

in an effort to determine how much they magnify the speech sounds and also the quality of the reproduced speech. The data thus obtained will be made available to the various medical societies.

He pointed out some of the physical relationships of the hearing mechanism, and showed what would happen to the ability to hear if certain mechanical things were done to parts of this mechanism. This will help in interpreting the so-called audiograms.

By means of a chart, he pictured the limits of hearing both in pitch and in intensity in an effort to get a more or less definite picture in relation to certain norms. At pitches around 2,000 cycles per second, it requires one thousandth of a dyne pressure to produce a just perceptible tone. At 60 cycles per second it requires much greater intensity (100,000 times as great). If the pressure increases above the normal threshold curve, it is found that there is a definite intensity at which the ear feels the sound. The tones which the ear is capable of hearing lie within these limits. The points at which the ear both hears and feels the tone are important, for they give the upper and lower limits of pitch. In the vast majority of cases reported on the upper and lower limits of pitch, the investigator has said nothing about the intensity of the tone, so the findings have serious limitations. The intensity of sound as used by physicists is the amount of power going through a given area perpendicular to the direction in which the sound is travelling. The range in intensity from the threshold to the maximum that the ear can tolerate is about ten thousand billion times. These intensity units are impracticable for ordinary use. Another reason why they are unsuitable is because equal changes in intensity on such a scale do not correspond at all to equal changes in loudness as sensed by the ear.

If one chooses units, so that about 130 of them cover this range, and relates them logarithmically to the intensity units, a scale is secured which represents the way the ear actually hears; equal changes on this new scale correspond to a change in intensity, which is just sufficient for the ear to distinguish that there has been a change. When a patient is deafened, his degree of deafness is described by stating the number of units from the norm that is necessary just to make him hear. When a degree of deafness or loss in hearing is determined for tones of various pitches and represented graphically on an appropriate chart, the resulting curve is called an audiogram. As one's experience increases with correlating the type of audiogram corresponding to various hearing defects, the audiogram will become a valuable aid in diagnosis as well as in prescribing adequate hearing aids.

The effect on the audiogram of a few cases of definite ear defects were then considered. Assuming the modified Helmholtz theory of hearing, as recently developed in the Bell Telephone Laboratories as correct, then one can calculate the effect on the audiogram of certain nerve degeneration. If the degeneration starts near the oval window, there will be a dip in the audiogram at the high frequencies. As the disease travels inward, the point at which the audiogram charts break away from the normal shifts toward the lower frequencies. From the position of the break, by means of a chart, recently published by Wegel and Lane, one can determine the exact distance the disease has proceeded along the basilar membrane. The patient becomes noticeably deaf only when the break reduces the important frequencies used in speech. These ideas were illustrated by charts.

If there is an obstruction in the acoustic path from the outside ear to the inner ear, it usually produces a general lowering of the audiogram. Certain types of obstruction would cause a lowering of the low frequencies, and others a lowering of the high frequencies.

Dr. Fletcher thought that if there was some way of making a survey in the schools so as to catch the early stages of degeneration, the further development of a good many cases of deafness could be prevented.

In patients on whom an operation is performed, and the drum and ossicles are removed, one can compute from the mechanics involved the actual hearing loss that the patient would experience, under such circumstances. No accurate records have been made in these cases until recently, but in most of them the amount of deafness is just what it should be according to the mechanics of the ear. However, such operations frequently affect the inner ear, and under such circumstances any kind of an audiogram might result. If the mechanical transformer in the middle ear is removed, the pressure on the oval window should be reduced a certain amount resulting in a definite decrease in hearing. Definite measurements have shown this to be about 30 to 35 units on the new scale.

It has been found experimentally that one can reduce the hearing only about 20 units by putting the hand over the ears. Such a reduction does not interfere with the ordinary conversation. It has also been found that pouring the ear full of wax will not stop outside sounds entirely, as it is sometimes supposed to do. About the same hearing loss is obtained in this way as that obtained by removing the drum and ossicles, or from moistening the finger tips and placing them in the ear. There is no simple method for excluding the sound from the inner ear.

Dr. Fletcher said that a convenient way to describe the effects of noise on the ability to hear is to say that the person immersed in such a noise has a temporary hearing loss. As long as the noise is present, this hearing loss is as real as though the person were permanently deafened. If a high pitched noise is present, so far as any interpretation is concerned, it has the same effect as nerve deafness. If a low pitched sound, low in intensity, is present, it will produce only a depression in the audiogram. However, as it increases in intensity, it will not only cause a lowering in the pitch range near the pitch of the tone, but throughout the whole range, so that neither high nor low tones can be heard. By properly choosing the quality and intensity of the noise, an ear that is normal can be made to give an audiogram corresponding to any type of deafness.

DISCUSSION

Dr. J. Gordon Wilson said that at first glance the two parts of the program appeared to have little connection, but this was not so. Quackery can only thrive in ignorance, and ignorance can best be combatted by the results of investigations carried into the realm of the doubtful and unknown. Quackery is not always so crude as Dr. Cramp's paper suggested. It is often subtle and persuasive. To meet quackery one must be well informed and ready to state the truth with simplicity and with patience. But to fight quackery is but a small part of our duties. We must be ready to heed the cry for help to which quackery responds. One loses patience with the superior otologist who complacently tells his patient that for a particular malady nothing can be done — and lets it go at that. The cry for help is often urgent and pathetic, and until we answer it painstakingly, hônestly and intelligently, some of the responsibility for quackery rests on our shoulders.

Dr. Wilson confined himself chiefly to Dr. Fletcher's discussion, stating that until recently the fascination of electrophysics overshadowed the realm of acoustics, and few physicists devoted much of their time to the investigation of the properties of sound and their application. Now the practical application of electrophysics to acoustic problems has enriched the domain of otology.

It has long been recognized by physicists that the estimation of the minimum audibility of sound at all pitches is of prime importance in the study of audition. But the range of tones to be examined, and the difficulty of obtaining suitable apparatus capable of examining such audibility over so great a range, have proved a great barrier. Not only is the estimation of the minimum audibility of sound at all pitches important for the understanding of audition, but the ascertaining of the minimum audibility at various pitches is of importance in otology, to determine the degree of impairment of hearing, to localize the pathologic changes when clinical examinations may fail, and to estimate the results of treatment. Tuning forks have been our mainstay, but tuning forks have great limitations. They are wanting in scientific accuracy, since we cannot well measure the amplitude of their vibration. Each vibration period varies in each set and alters with use. It is impossible to give a percentage estimate of the impairment of hearing compared with normal by means of forks, for the amplitude of the tuning fork, when it ceases to be heard in the two ears, is difficult to estimate.

Until recently, we have had no satisfactory means of measuring the intensity of the sound perceived. There was no certainty in regard to the position in the sound scale in which the maximum sensitivity for sound perception lies. By graphs, such as the audiometer gives, we can get such knowledge in normal and in defective ears, and an endeavor can be made to apply data so obtained to pathologic conditions in the ear.

What impresses one is the cooperation that now is taking place. The perfecting of the telephone and the problems of wireless communication have compelled the electrical engineer to take careful note of the mechanism of hearing. He seeks to understand the anatomic structure of the hearing organ and its nerve mechanism, and recognizes that such information can best be obtained from the otologist. This association is compelling the physiologist and otologist to endeavor to grasp the physical problems which the ear presents. A simple example of the results of such an association and interchange of ideas has been the very plausible suggestion made by an electrical engineer, who has paid considerable attention to acoustic problems, that in the diaphragm of the loud speaker we have a structure analogous in physical properties to the drum membrane.

From this association, otology is destined to receive great benefit, and we already see an awakening of interest in the fundamental problems of hearing. It has been characteristic of this reawakening that the work in this country has not been concentrated in one area and that it has not been confined to the pure scientist. The pioneer work of Professor Seashore (to whom we owe the name audiometer) stimulated Dr. Dean and Dr. Bunch in Iowa. The laboratory at Geneva, Ill., where Dr. Sabine for many years has worked on problems of acoustics, now gives willing aid to the otologist. In Los Angeles, the experiments carried on by Dr. Knudson and Dr. Jones, not only have given us scientific data of importance, but have furnished practical points of

far reaching significance. The electrical engineers of the Bell Telephone Company not only are in constant touch with otologists, but are showing their desire to cooperate with them fully and freely.

Dr. Fletcher had told a little of the thought and patient work that has gone into the building of the Western Electric audiometer. There are many practical points in this instrument which should appeal to the otologist.

1. The instrument offers simplicity in operation.

2. It produces a series of pure tones whose frequency or pitch can be varied in steps throughout the scale of audition (from 32 to 16,000 vibrations per second in twenty logarithmic steps).

3. The loudness of each tone can be varied in steps throughout the tone. The intensity (loudness) as it strikes the drum membrane is measured in sensation units, which can readily be transformed into absolute units (dynes). There is no standard sensation unit to measure hearing, and there is difficulty in comparing audiometric measurements from various investigations. Once a standard is accepted, the present confusion in records will disappear. In this instrument a logarithmic system of units (loudness) is adopted, which the Western Electric engineers believe will answer well the needs for a practical system.

4. By means of charts supplied, the findings may be quickly plotted, and the amount of hearing loss clearly indicated.

Dr. Wilson thought the steps in frequency in the upper limits might well be smaller. Jumps of two or three thousand vibrations seemed rather great. Breaks have been found occurring within such limits which have a meaning to the otologist. For example, a marked depression in the hearing, a so-called "island of deafness" occurring at about 3,500 vibrations, could not be detected by the instrument. The steps for the loudness appeared to be adequate.

Dr. Wilson had made a number of audiometric charts, but had found it difficult to synthesize them into definite types corresponding to definite ear lesions. The possibility of a synthesis was to be expected, how completely he did not know. The following were some of the practical findings made apparent by his audiometric charts:

1. In all forms of deafness the region of hearing of speech (the middle range) is more resistant to disease. This appears to be due to the fact that here lies the minimum intensity to produce the sensation of hearing.

2. The usual teaching — that nerve deafness affects the higher tones and conduction deafness the lower — requires modification, in many cases of conduction deafness the higher notes go early and in nerve deafness the whole scale may be depressed.

3. In otosclerosis, some of their charts indicate that one of the earliest signs is a contraction of the upper tone limit. It may be some time after that the lower notes become markedly affected, and that we can be sure we are dealing with that clinical entity called otosclerosis. To him, this characteristic has been one of the most interesting findings brought out by the audiometric charts. Further observation is required in regard to its frequency, for it obviously has a bearing on the genesis of this intractible disease.

4. Choked labyrinth has particularly attracted his attention. That it exists he has no doubt, but one hesitates to say that it will yield data comparable to the choked visual disk. In tumors of the posterior cranial fossa hearing is almost universally lowered. He was not prepared to synthesize his findings, but thought the following points in the graphs were of interest. The only case in which they found a complete tone gap occurred in a tumor of the cerebellum.

It was present on both sides and extended from 1,600 to 2,700 double vibrations. After decompression operation, the gap was narrowed and the hearing was improved. Another characteristic is the rapid fall of the curve of hearing in frequencies above 3,500, and with it the disappearance of hearing of all sounds. A mathematician, without knowledge of their cases, was asked to classify a series of their graphs in which were included cerebellar cases, and he grouped all their brain tumor cases in one group of three. He wished it clearly understood that his observations have been made on too few cases to be anything but suggestive.

5. A scientific basis is here presented on which devices may be built to suit various types of deafness. Though little can be reported as yet, he hoped the time would come when the otologist will write out the audiograms, and the electrical engineer will be able to supply the aid best suited to the needs. It is well to recognize that many factors enter into the fitting of hearing devices of an electrical nature, as Dr. Fletcher had stated in a recent paper. In addition to audiometric measurements, there has to be ascertained the loudness best suited in a particular case to interpret speech, for great loudness over the telephone introduces subjective tones which interfere with adequate interpretation.

Dr. Wilson believed that at no time in the history of otology has the outlook for progress been so bright. It requires neither a prophet nor the son of a prophet to predict the oncoming of waves of increasing knowledge in the physics of audition and in the pathology of ear disease. To meet this, the clinical otologist must be ready to apply the information so obtained to the patients he is called on to treat.

Dr. C. C. Bunch said that he had been much interested in the problems of audiometry since 1917. When the pitch range audiometer was demonstrated to the otologic fraternity at Atlantic City in 1919, it was rather problematic as to the reception on the part of many of work along the clinical lines of functional tests of hearing by one not trained along medical lines. The presence of the large group of men and their close attention to the presentation by Dr. Fletcher had shown that medical men are interested in those problems, and wish to have the aid of the physicists in the solution of the problems of sound measurement.

But physicists have also shown an awakening in this line of research. Few, however, are actively engaged in the problems of sound if one may judge by the number of articles presented on the subject of sound in the *Science Abstracts*. The field of general physics and electricity are of much greater interest to them. A few years since, a physicist asked an official of the Western Electric Company, as to the extent of their interest in the problems of acoustics and he was told that they were not at all interested. But now their interest has been aroused, even to the extent of supporting an immense research laboratory with a great staff of engineers.

Relative to Dr. Fletcher's remarks concerning the function of the ossicles in the hearing process, Dr. Bunch thought it was difficult to estimate this effect on the evidence presented in the audiograms. He stated that he had found patients who, after the radical mastoid operation, showed little loss of hearing, some were quite hard of hearing for tones throughout the entire range, while others were hard of hearing for high tones. Unless we are able to ascertain the functioning power of all parts of the conductive and per-

ceptive mechanism, it is difficult to determine the function of any one part. This is a problem which will require the careful support and study of many workers in the field.

Dr. Max Goldstein said that he had been very reticent about giving up the tuning forks, the Galton whistles and watch test, but had been intensely interested in the audiometer and had become a complete convert. This not only because it gives everything they had before in the testing mediums, but because in addition it affords a means of quantitatively measuring sounds. This the audiometer does accurately, and it is the one advantage that has been developed in otology in the whole plan of the functional test of hearing. A number of practical deductions have been developed from the audiometer.

Briefly, these are a means of differentiation of the types of deafness which are familiar to all in the more definite gross forms, new types of conduction mechanism impairment, and a graph for the low tones. The graph can be verified by tuning forks and whistles. If there is some reduction in the high tone scale, it is evident that one is not dealing with nerve deafness. If there is a reduction of the low pitched sounds and a fairly well marked approximation to the normal in the middle of the scale, and again, a reduction in the high pitched sound, one is dealing with otosclerosis. These three types of graphs may be considered classical and are entitled to all of the consideration that can be given them.

In the children with residual hearing, there is in the speech scale a tone that goes from 300 to 3,000 total vibrations per second. If a deaf child still has, even in the lower part, a hearing capacity within these limits, there is still some hope of stimulating the hearing by some mechanism which remains to be developed.

Dr. Goldstein thought the bone conduction apparatus that is being developed in connection with the audiometer would perhaps need a different standard, but there is a possibility in the development of the telephone receiver that will be just as helpful as the present tests.

He expressed his homage to the electrical engineers of the Western Electric Company, particularly for their scientific and helpful work in connection with the medical profession. In all cases they have practical evidence that the audiometer and the otogram will be of inestimable value in otology.

Dr. Fletcher said that he had talked on the data which might be obtained with an audiometer, and not on the machine itself. He had tried to point out the new scale for measuring hearing which could be used in the graph form called the audiogram. This can be done with tuning forks as well as with other kinds of audiometers. He stated that the Bureau of Standards was now ready to calibrate forks, so that with them one can get hearing loss directly on this new scale. To do this, one had only to take the difference in hearing times for the normal and for the patient and multiply by a constant. Probably as accurate results can be obtained with the tuning forks as with the audiometer if one is careful and takes sufficient time, but one can get the same result with the audiometer much more rapidly. In a good many cases, however, tuning will still be the most practical method to use, but he suggested that the data be expressed in terms of this new scale, then the results of the different observers may be directly compared.

Book Review

OTOLOGICAL SURGERY. By SAMUEL J. KOPETZKY, M.D. Price, $8. New York: Paul B. Hoeber, 1925.

This is a volume of 539 pages, including an excellent author and subject index. It is the most important contribution on this subject that has appeared for a number of years. The author's literary treatment is a method quite his own, and he presents a well thought out rationale for each and every indication for operative interference. His discussions are always based on a careful study of the anatomy and pathology of the region involved. Many of the details regarding laboratory technic he leaves for general textbooks treating of these topics. The literature references are ample, and will be of great assistance to those who desire to look up the original texts.

In a text of this sort when the author does not hesitate to take a definite stand on the important problems, a reviewer naturally finds statements where there is room for a difference of opinion, such, for example, is the author's reluctance to an early incision of the drum membrane on page 60, and the assumption that the occurrence of facial paralysis in acute otitis media is necessarily an indication for a mastoid operation. Paralysis of the facial nerve is not infrequently observed in the mildest types of acute otitis media, from which recovery, when it does take place, is just as likely to occur without as with any operation. The statement is made that in the coalescent type of mastoiditis the operation should be undertaken as early as thirty-six to seventy-two hours after the onset of mastoid symptoms. This, in the absence of any threatening symptoms, seems a rather hasty procedure since evidences of softening could hardly be expected to be detected so early. The author makes clear the distinction between the relatively harmless type of chronic suppurative otitis media which requires no operative treatment, and the type recognized as dangerous when a radical mastoid operation should be considered. We fail to find any discussion of the inadvisability of undertaking at one time a bilateral radical mastoid operation because of the risk of losing the hearing in both ears, although he does discuss contraindications to this operation for the one ear on which the patient may have to rely for hearing. We were glad to see his emphasis of the point that a radical mastoid operation is not undertaken primarily to stop a discharging ear, and a corollary that the persistence of more or less moisture after operation cannot be looked on as an indication that the result of the operation has been a failure.

The anatomy of this region is, on the whole, clearly presented and to the anatomic references in the book few exceptions can be taken. The statement on page 165 that the upper wall of the tympanum, the tegmen, is formed in part of the os tympanum is not correct. Only the squamous and petrous bones enter into the formation of the tegmen, their point of union constituting the petrosquamosal suture. The author persists in referring to the antrum as the mastoid antrum, leaving the impression that this forms but one of the mastoid cells. The correct anatomic term for this space is tympanic antrum which does convey the proper idea of its relation as a part of the tympanic cavity. The statement on page 260 that the venous sinuses are lined with epithelium is a mistake. The reference on page 281 to the vein draining the labyrinth as

the internal auditory vein leaves the impression that the venous blood from the labyrinth is drained from the vessel lying in the internal auditory meatus. As a matter of fact, there are two veins in the human ear which drain the labyrinth, the vein of the aqueductus cochleae and the vein of the aqueductus vestibuli. There is no vein draining the labyrinth which lies in the internal meatus.

The author concludes his book with an interesting chapter on cases illustrating points in the text, together with a critical discussion of the same. This constitutes an excellent method of emphasizing and elucidating points brought out in the text.

THE ARCHIVES OF OTOLARYNGOLOGY is published by the American Medical Association to stimulate research in the field of laryngology and otology, and to disseminate knowledge in this department of medicine.

Manuscripts for publication, books for review, and correspondence relating to the editorial management should be sent to Dr. George E. Shambaugh, Editor-in-Chief, 122 South Michigan Avenue, Chicago, or to any other member of the Editorial Board. Communications regarding subscriptions, reprints, etc., should be addressed, ARCHIVES OF OTOLARYNGOLOGY, American Medical Association, 535 North Dearborn Street, Chicago.

Articles are accepted for publication on condition that they are contributed solely to the ARCHIVES OF OTOLARYNGOLOGY. Manuscripts must be typewritten, preferably double spaced, and the original copy should be submitted. Zinc etchings and halftones of illustrations will be supplied by the publisher when the original illustrations warrant.

Footnotes and bibliographies should conform to the style of the Quarterly Cumulative Index, published by the American Medical Association. This requires, in order given: name of author, title of article, name of periodical, with volume, page, month—day of month if weekly—and year. A complete list of abbreviations for standard periodicals, together with a full discussion of the style of the A. M. A. publications, appears in The Art and Practice of Medical Writing, a comprehensive book on the preparation of medical manuscripts, published by the American Medical Association. Price, $1.50.

Matter appearing in the ARCHIVES OF OTOLARYNGOLOGY is covered by copyright, but, as a rule, no objection will be made to its reproduction in reputable medical journals if proper credit is given. However, the reproduction for commercial purposes of articles appearing in the ARCHIVES OF OTOLARYNGOLOGY, or in any of the other publications issued by the Association, will not be permitted.

Authors will receive one hundred reprints free; additional reprints may be obtained at cost.

The ARCHIVES OF OTOLARYNGOLOGY is issued monthly. Annual subscription price (two volumes): Domestic, $6.00; Canadian, $6.40; foreign, $6.75, including postage. Single copies, 75 cents, postpaid.

Checks, etc., should be made payable to the AMERICAN MEDICAL ASSOCIATION.

OTHER PERIODICAL PUBLICATIONS
of the American Medical Association

THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION—Weekly. Covers all the medical sciences and matters of general medical interest. Illustrated. Annual subscription price (two volumes): Domestic, $5.00; Canadian, $6.50; foreign, $7.50. Single copies, 20 cents.

ARCHIVES OF INTERNAL MEDICINE—Monthly. Devoted to the publication of advanced, original clinical and laboratory investigations in internal medicine. Illustrated. Annual subscription price (two volumes): Domestic, $5.00; Canadian, $5.40; foreign, $5.75. Single copies, 75 cents.

AMERICAN JOURNAL OF DISEASES OF CHILDREN—Monthly. Presents pediatrics as a medical science and as a social problem. It includes carefully prepared collective abstracts based on recent pediatric literature, abstracts from foreign and domestic literature, book reviews, society transactions, etc. Illustrated. Annual subscription price (two volumes): Domestic, $4.00; Canadian, $4.30; foreign, $4.50. Single copies, 50 cents.

ARCHIVES OF DERMATOLOGY AND SYPHILOLOGY—Monthly. Devoted to advancing the knowledge of and progress in cutaneous diseases and syphilis. Publishes original contributions and full abstracts of the literature on these two subjects, transactions of the important dermatological societies, book reviews, etc. Illustrated. Annual subscription price (two volumes): Domestic, $8.00; Canadian, $8.40; foreign, $8.75. Single copies, 85 cents.

ARCHIVES OF NEUROLOGY AND PSYCHIATRY—Monthly. A medium for the presentation of original articles on nervous and mental diseases, with abstracts from foreign and domestic literature, book reviews, society transactions, etc. Illustrated. Annual subscription price (two volumes): Domestic, $8.00; Canadian, $8.40; foreign, $8.75. Single copies, 85 cents.

ARCHIVES OF SURGERY—Monthly. Devoted largely to the investigative and clinical phases of surgery, with monthly reviews on orthopedic and urologic surgery. Well illustrated. Annual subscription price (two volumes): Domestic, $8.00; Canadian, $8.40; foreign, $8.75. Single copies, 85 cents.

ARCHIVES OF PATHOLOGY AND LABORATORY MEDICINE—Monthly. A periodical devoted to the publication of original contributions in the field of pathology, with abstracts from foreign and domestic literature, book reviews, the transactions of special societies, etc. Illustrated. Annual subscription price (two volumes): Domestic, $6.00; Canadian, $6.40; foreign, $6.75. Single copies, 75 cents.

QUARTERLY CUMULATIVE INDEX TO CURRENT MEDICAL LITERATURE—Quarterly. A complete subject and author index to the worth-while current medical literature of the world. Issued four times a year. Fourth volume bound for permanent reference. Subscription price, calendar year: Domestic, $8.00; Canadian, $8.50; foreign, $8.75.

AMERICAN MEDICAL ASSOCIATION

535 North Dearborn St. CHICAGO

CONTENTS

PAGE

Blastomycosis of the Larynx. Chevalier Jackson, M.D., Philadelphia 99

Auditory Acuity Tests: Comparison of the Results made with Two Types of Audiometers. C. C. Bunch, Ph.D., Iowa City 108

Touch as a Substitute for Hearing in the Interpretation and Control of Speech. Robert H. Gault, Ph.D., Washington, D.C 121

Quantitative Tests on Bone and Air Acuity in Paracusis Willisi: Report of Two Cases, Together with a Note on the Interrelation of Audiometric Tests. A. G. Pohlman, M.D., St. Louis, and F. W. Kranz, Ph.D., Geneva, Ill 136

The Alternating Weber Tests and a New Method of Determining Weber Lateralization in Doubtful Cases. Douglas Macfarlan, M.D., Philadelphia 144

Unusual Types of Mastoiditis. Joseph I. Kemler, M.D., Baltimore 148

Meningococcic Mastoiditis. O. Jason Dixon, M.D., Kansas City, Mo 151

Clinical Note:

The Nasal Ganglion: Observations Concerning Vertigo, Parageusia and Glossodynia. Case Report. Simon L. Ruskin, M.D., New York 153

Progress in Otolaryngology. A Summary of the Bibliographic Material Available in the Field of Otolaryngology. Anatomy and Physiology of the Ear: Review of the Literature from September, 1924, to October, 1925. Philip E. Meltzer, M.D., Boston 155

News and Comment:

American Laryngological, Rhinological and Otological Society 174

Pacific Coast Oto-Ophthalmological Society 174

Local Society Meetings 174

Abstracts from Current Literature 175

Society Transactions:

Chicago Laryngological and Otological Society 196

Book Review 203